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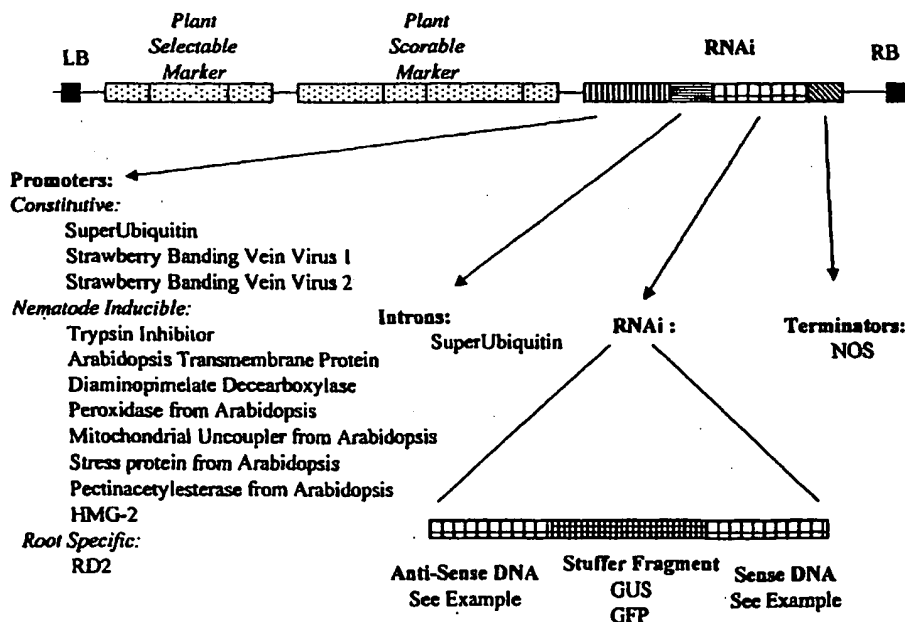
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[Continued on next page]

(54) Title: MATERIALS AND METHODS FOR THE CONTROL OF NEMATODES



(57) Abstract: The subject invention provides novel methods and compositions for controlling nematodes. More specifically, the subject invention provides RNAi molecules, polynucleotide sequences, and methods of using these sequences in nematode control.

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DESCRIPTION

MATERIALS AND METHODS FOR THE CONTROL OF NEMATODES

Background of the Invention

[0001] Plant parasitic nematodes, such as root-knot nematodes (*Meloidogyne* species) and cyst nematodes (*Globodera* and *Heterodera*), attack nearly every food crop, and are among the world's most damaging agricultural pests. For example, root-knot nematodes parasitize more than 2,000 plant species from diverse plant families and represent a tremendous threat to crop production world-wide. These biotrophic pathogens have evolved highly specialized and complex feeding relationships with their hosts.

[0002] Nematodes cause millions of dollars of damage each year to turf grasses, ornamental plants, and food crops. Efforts to eliminate or minimize damage caused by nematodes in agricultural settings have typically involved the use of soil fumigation with materials such as chloropicrin, methyl bromide, and dazomet, which volatilize to spread the active ingredient throughout the soil. Such fumigation materials can be highly toxic and may create an environmental hazard. Various non-fumigant chemicals have also been used, but these too create serious environmental problems and can be highly toxic to humans.

[0003] Some research articles have been published concerning the effects of δ -endotoxins from *B. thuringiensis* species on the viability of nematodes. See, for example, Bottjer, Bone and Gill ([1985] *Experimental Parasitology* 60:239-244); Ignoffo and Dropkin (Ignoffo, C.M., Dropkin, V.H. [1977] *J. Kans. Entomol. Soc.* 50:394-398); and Ciordia, H. and W.E. Bizzell ([1961] *Jour. of Parasitology* 47:41 [abstract]). Several patents have issued describing the control of nematodes with *B.t.* See, for example, U.S. Patent Nos. 4,948,734; 5,093,120; 5,281,530; 5,426,049; 5,439,881; 5,236,843; 5,322,932; 5,151,363; 5,270,448; 5,350,577; 5,667,993; and 5,670,365. The development of resistance by insects to *B.t.* toxins is one obstacle to the successful use of such toxins.

[0004] The pesticidal activity of avermectins is well known. The avermectins are disaccharide derivatives of pentacyclic, 16-membered lactones. They can be divided into four major compounds: A_{1a}, A_{2a}, B_{1a}, and B_{2a}; and four minor compounds: A_{1b}, A_{2b}, B_{1b}, and B_{2b}. The isolation and purification of these compounds is also described in U.S. Patent No. 4,310,519, issued January 12, 1982. Avermectin B_{2a} is active against the root-knot nematode, *Meloidogyne incognita*. It is reported to be 10-30 times as potent as commercial contact nematicides when incorporated into soil at 0.16-0.25 kg/ha (Boyce Thompson Institute for Plant Research 58th Annual Report [1981]; Putter, I. *et al.* [1981] "Avermectins: Novel Insecticides, Acaracides, and Nematicides from a Soil Microorganism," *Experientia* 37:963-964). Avermectin B_{2a} is not toxic to tomatoes or cucumbers at rates of up to 10 kg/ha.

[0005] Fatty acids are a class of natural compounds which occur abundantly in nature and which have interesting and valuable biological activities. Tarjan and Cheo (Tarjan, A.C., P.C. Cheo [1956] "Nematocidal Value of Some Fatty Acids," Bulletin 332, Contribution 884, Agricultural Experiment Station, University of Rhode Island, Kingston, 41 pp.) report the activity of certain fatty acids against nematodes. In 1977 Sitaramaiah and Singh (Sitaramaiah, K., R.S. Singh [1977] *Indian J. Nematol.* 7:58-65) also examined the response of nematodes to fatty acids. The results of these tests with short chain acids were equivocal, showing nematode-inhibitory action in some instances and stimulatory activity in other instances. Phytotoxicity of these acids was observed at higher concentrations. The short chain fatty acids were also examined by Malik and Jairajpuri (Malik, Z., M.S. Jairajpuri [1977] *Nematol. medit.* 12:73-79), who observed nematode toxicity at high concentrations of the fatty acids.

[0006] Notwithstanding the foregoing (some of the limitations of and problems associated with these approaches are discussed above), there is a need for safe and effective alternatives for controlling nematodes.

[0007] One method for disrupting normal cellular processes is by the use double-stranded interfering RNA (RNAi), or RNA-mediated interference (RNAi). When RNAi corresponding to a sense and antisense sequence of a target mRNA is introduced into a cell, the targeted mRNA is degraded and protein translation of that message is stopped. Although not yet fully understood, the mechanism of this post-transcriptional gene

silencing appears to be at least partially due to the generation of small RNA molecules, about 21 - 25 nucleotides in length, that correspond to the sense and antisense pieces of the RNAi introduced into the cell (Bass, B. L. [2000] "Double-stranded RNA as a template for gene silencing" *Cell* 101:235-238).

[0008] The specificity of this gene silencing mechanism appears to be extremely high, blocking expression only of targeted genes, while leaving other genes unaffected. A recent example of the use of RNAi; to inhibit genetic function in plants used *Agrobacterium tumefaciens*-mediated transformation of *Arabidopsis thaliana* (Chuang, C.-F. and E. M. Meyerowitz [2000] "Specific and heritable genetic interference by double-stranded RNA in *Arabidopsis thaliana*" *Proc. Natl. Acad. Sci. USA* 97:4985-4990). Chuang *et al.* describe the construction of vectors delivering variable levels of RNAi targeted to each of four genes involved in floral development. Severity of abnormal flower development varied between transgenic lines. For one of the genes, AGAMOUS (AG), a strong correlation existed between declining accumulation of mRNA and increasingly severe phenotypes, suggesting that AG-specific endogenous mRNA is the target of RNAi.

Brief Summary of the Invention

[0009] The subject invention provides novel methods and compositions for controlling nematodes. More specifically, the subject invention provides polynucleotide sequences that encode nematode genes, RNAi that selectively targets mRNA transcripts of these essential nematode genes, and methods of using these sequences in nematode control strategies. Such sequences for use according to the subject invention are summarized in Appendix 1. RNAi molecules disclosed herein can be used to inhibit the expression of one or more of these genes in nematodes.

Brief Description of the Drawings

[00010] **Figure 1:** Modular Binary Construct System (MBCS): A series of six, 8-base cutter restriction enzyme sites has been placed between the left and right Ti borders of a previously created kan^R/tet^R binary plasmid.

[00011] **Figure 2:** An exemplary shuttle vector created for cloning of useful DNA fragments by containing the multi-cloning site (MCS) of a modified Bluescript plasmid flanked by 8-base restriction sites.

[00012] **Figure 3:** An exemplary shuttle vector with exemplary inserts.

[00013] **Figure 4:** A suggested RNAi binary vector with exemplary inserts.

[00014] **Figure 5:** Exemplary selectable markers for MBCS.

[00015] **Figure 6:** Exemplary scorable markers for MCBS.

[00016] **Figure 7:** Exemplary RNAi binary vector.

[00017] **Figure 8:** Exemplary RNAi shuttle vector.

Brief Description of the Sequences

[00018] Brief Description of the Sequences can be found in Appendix I.

Detailed Disclosure of the Invention

[00019] The subject invention provides novel methods and compositions for controlling nematodes. More specifically, the subject invention provides polynucleotide sequences and methods of using these sequences in nematode control strategies. A preferred method for controlling nematodes according to the subject invention provides materials and methods for controlling nematodes by using double-stranded interfering RNA (RNAi), or RNA-mediated interference (RNAi). The terms RNAi and RNAi are used interchangeably herein unless otherwise noted.

[00020] In one embodiment of the invention, RNAi molecules are provided which are useful in methods of killing nematodes and/or inhibiting their growth, development, parasitism or reproduction. RNAi molecules of the invention are also useful for the regulation of levels of specific mRNA in nematodes.

[00021] dsRNA (RNAi) typically comprises a polynucleotide sequence identical to a target gene (or fragment thereof) linked directly, or indirectly, to a polynucleotide

sequence complementary to the sequence of the target gene (or fragment thereof). The dsRNA may comprise a polynucleotide linker (stuffer) sequence of sufficient length to allow for the two polynucleotide sequences to fold over and hybridize to each other; however, a linker sequence is not necessary. The linker (stuffer) sequence is designed to separate the antisense and sense strands of RNAi significantly enough to limit the effects of steric hindrances and allow for the formation of dsRNA molecules.

[00022] RNA containing a nucleotide sequence identical to a fragment of the target gene is preferred for inhibition; however, RNA sequences with insertions, deletions, and point mutations relative to the target sequence can also be used for inhibition. Sequence identity may be optimized by sequence comparison and alignment algorithms known in the art (see Gribskov and Devereux, *Sequence Analysis Primer*, Stockton Press, 1991, and references cited therein) and calculating the percent difference between the nucleotide sequences by, for example, the Smith-Waterman algorithm as implemented in the BESTFIT software program using default parameters (e.g., University of Wisconsin Genetic Computing Group). Alternatively, the duplex region of the RNA may be defined functionally as a nucleotide sequence that is capable of hybridizing with a fragment of the target gene transcript.

[00023] As disclosed herein, 100% sequence identity between the RNA and the target gene is not required to practice the present invention. Thus the invention has the advantage of being able to tolerate sequence variations that might be expected due to genetic mutation, strain polymorphism, or evolutionary divergence.

[00024] RNA may be synthesized either *in vivo* or *in vitro*. Endogenous RNA polymerase of the cell may mediate transcription *in vivo*, or cloned RNA polymerase can be used for transcription *in vivo* or *in vitro*. For transcription from a transgene *in vivo* or an expression construct, a regulatory region (e.g., promoter, enhancer, silencer, splice donor and acceptor, polyadenylation) may be used to transcribe the RNA strand (or strands). Inhibition may be targeted by specific transcription in an organ, tissue, or cell type; stimulation of an environmental condition (e.g., infection, stress, temperature, chemical inducers); and/or engineering transcription at a developmental stage or age. The RNA strands may or may not be polyadenylated; the RNA strands may or may not be capable of being translated into a polypeptide by a cell's translational apparatus. RNA

may be chemically or enzymatically synthesized by manual or automated reactions. The RNA may be synthesized by a cellular RNA polymerase or a bacteriophage RNA polymerase (e.g., T3, T7, SP6). The use and production of an expression construct are known in the art (see, for example, WO 97/32016; U.S. Pat. Nos. 5,593,874; 5,698,425; 5,712,135; 5,789,214; and 5,804,693; and the references cited therein). If synthesized chemically or by *in vitro* enzymatic synthesis, the RNA may be purified prior to introduction into the cell. For example, RNA can be purified from a mixture by extraction with a solvent or resin, precipitation, electrophoresis, chromatography, or a combination thereof. Alternatively, the RNA may be used with no or a minimum of purification to avoid losses due to sample processing. The RNA may be dried for storage or dissolved in an aqueous solution. The solution may contain buffers or salts to promote annealing, and/or stabilization of the duplex strands.

[00025] Preferably and most conveniently, RNAi can be targeted to an entire polynucleotide sequence of a gene set forth herein. Preferred RNAi molecules of the instant invention are highly homologous or identical to the polynucleotides summarized in Appendix 1. The homology is preferably greater than 90% and is most preferably greater than 95%.

[00026] Fragments of genes can also be targeted. These fragments are typically in the approximate size range of about 20 nucleotides. Thus, targeted fragments are preferably at least about 15 nucleotides. In certain embodiments, the gene fragment targeted by the RNAi molecule is about 20-25 nucleotides in length. However, other size ranges can also be used. For example, using a *C. elegans* microinjection assay, RNAi "fragments" of about 60 nucleotides with between 95 and 100% identity (to a nematode gene) were determined to cause excellent inhibition.

[00027] Thus, RNAi molecules of the subject invention are not limited to those that are targeted to the full-length polynucleotide or gene. The nematode gene product can be inhibited with a RNAi molecule that is targeted to a portion or fragment of the exemplified polynucleotides; high homology (90-95%) or identity is also preferred, but not necessarily essential, for such applications.

[00028] The polynucleotide sequences identified in Appendix A and shown in the Sequence ID listing are from genes encoding nematode proteins having the functions

shown in Appendix 1. The genes exemplified herein are representative of particular classes of proteins which are preferred targets for disruption according to the subject invention. These classes of proteins include, for example, proteins involved in ribosome assembly; neurot transmitter receptors and ligands; electron transport proteins; metabolic pathway proteins; and protein and polynucleotide production, folding, and processing proteins.

[00029] Genetic regulatory sequences, such as promoters, enhancers, and terminators, can be used in genetic constructs to practice the subject invention. Such constructs themselves can also be used for nematode control. Various constructs can be used to achieve expression in specific plant tissues (by using root specific promoters, for example) and/or to target specific nematode tissues (by using targeting elements or adjacent targeting sequences, for example).

[00030] In a specific embodiment of the subject invention, plant cells, preferably root cells, are genetically modified to produce at least one RNAi that is designed to be taken up by nematodes during feeding to block expression (or the function of) of a target gene. As is known in the art, RNAi can target and reduce (and, in some cases, prevent) the translation of a specific gene product. RNAi can be used to reduce or prevent message translation in any tissue of the nematode because of its ability to cross tissue and cellular boundaries. Thus, RNAi that is contacted with a nematode by soaking, injection, or consumption of a food source will cross tissue and cellular boundaries. RNAi can also be used as an epigenetic factor to prevent the proliferation of subsequent generations of nematodes.

[00031] Nematode polynucleotide sequences disclosed herein demonstrate conserved nucleotide motifs among different nematode genera. Conserved nucleotide motifs strongly suggest that these sequences are associated with viability and/or parasitism and are functionally conserved and expressed in both *Meloidogyne incognita* (root-knot nematode) and *Globodera rostochiensis* and *Globodera pallida* (potato cyst nematodes). The use of these polynucleotides, and RNAi inhibitors thereof, is advantageous because such RNAi can be designed to have broad RNAi specificity and are thus useful for controlling a large number of plant parasitic nematodes *in planta*. Because the genes identified in this disclosure are associated with nematode survival

and/or parasitism, RNAi inhibition of these genes (arising from contacting nematodes with compositions comprising RNAi molecules) prevents and/or reduces parasitic nematode growth, development, and or parasitism.

[00032] Methods of the subject invention include the transformation of plant cells with genes or polynucleotides of the present invention, which can be used to produce nematode inhibitors or RNAi in the plants. In one embodiment, the transformed plant or plant tissue can express RNAi molecules encoded by the gene or polynucleotide sequence introduced into the plant. Other nematode inhibitors contemplated by the invention include antisense molecules specific to the polynucleotide sequences disclosed herein. The transformation of plants with genetic constructs disclosed herein can be accomplished using techniques well known to those skilled in the art and can involve modification of the gene(s) to optimize expression in the plant to be made resistant to nematode infection and infestation. Furthermore, it is known in the art that many tissues of the transgenic plants (such as the roots) can be targeted for transformation.

[00033] RNA-mediated interference (RNAi) of gene expression. Several aspects of root-knot nematode biology make classical genetic studies difficult with this organism. Since root-knot nematodes reproduce by obligatory mitotic parthenogenesis, the opportunity to perform genetic crosses is not available. Microinjection of RNAi can be used to manipulate gene expression in *C. elegans* (Fire, A., S. Xu, M. K. Montgomery, S. A. Kostas, S. E. Driver, and C. C. Mello. [1998] "Potent and specific genetic interference by double-stranded RNA in *Caenorhabditis elegans*" *Nature* 391:806- 811). Microinjecting (into adult nematodes) RNAi can turn off specific genes in progeny worms complementary to the coding region of the genes. Moreover, gene inhibition occurs in progeny when RNAi is injected into the body cavity of the adult, indicating the ability of the RNAi to cross cellular boundaries. This RNAi injection method provides a molecular genetic tool that allows for analysis of gene function in root-knot nematodes.

[00034] RNAi can be taken up by *C. elegans* by simply soaking the nematodes in a solution RNAi. This results in targeted inhibition of gene expression in the nematode (Maeda, I., Y. Kohara, M. Yamamoto and A. Sugimoto [1999] "RNAi screening with a non-redundant cDNA set" International Worm Meeting, Madison, WI, abstract 565). Nematodes fed *E. coli* expressing RNAi also demonstrate targeted and

heritable inhibition of gene expression (Sarkissian, M., H. Tabara and C. C. Mello [1999] "A mut-6 screen for RNAi deficient mutants" International Worm Meeting, Madison, WI, abstract 741; Timmons, I. and A. Fire [1998] "Specific interference by ingested dsRNA" *Nature* 395:854; WO 99/32619, hereby incorporated by reference in its entirety).

[00035] Accordingly, one aspect of the instant invention is directed to the control of nematodes comprising contacting nematodes with compositions comprising RNAi molecules specific to the nematode genes disclosed herein. The contacting step may include soaking the nematodes in a solution containing RNAi molecules, feeding nematodes RNAi molecules contained in microbes or plant cells upon which the nematode feeds, or injecting nematodes with RNAi. Nematodes can also be "contacted" and controlled by RNAi expressed in plant tissues that would be consumed, ingested, or frequented by nematodes.

[00036] The RNAi molecules provided to the nematodes may be specific to a single gene. A "cocktail" of RNAi molecules specific to various segments of a single gene can also be used. In addition, a "multigene cocktail" of RNAi molecules specific to two or more genes (or segments thereof) may be applied to the nematodes according to the subject invention.

[00037] In addition to RNAi uptake mediated by transgenic plants, nematodes can be directly transformed with RNAi constructs of cDNAs encoding secretory or other essential proteins to reduce expression of the corresponding gene. The transgenic animals can be assayed for inhibition of gene product using immunoassays or for reduced virulence on a host. Progeny of affected worms can also be assayed by similar methods.

[00038] Procedures that can be used for the preparation and injection of RNAi include those detailed by Fire *et al.*, (1998; <ftp://ciw1.ciwemb.edu>). Root-knot nematodes can be routinely monoxenically cultured on *Arabidopsis thaliana* roots growing on Gamborg's B-5/Gelrite® media. This nematode-host pathosystem is ideally suited for these microinjection experiments since limited root galling results in the parasitic stages (late J2 through adult females) developing outside of the root for easy accessibility for injecting. Another advantage is the parthenogenic reproduction of root-knot nematodes, which makes fertilization by males unnecessary for egg production. The RNAi can be injected into the body cavity of parasitic stages of root-knot nematodes

feeding on *A. thaliana* roots using microinjection. Control nematodes can be injected in parallel with only buffer or an unrelated RNAi. Injected nematodes can be monitored for egg production, and the eggs can be collected for the assays described below. Female root-knot nematodes will typically survive and lay more than 250 eggs following 1 μ l injection of buffer.

[00039] Alternatively, methods are available for microinjecting materials directly into the plant root cells upon which nematodes feed: giant cells or syncytial cells (Böckenhoff, A. and F.M.W. Grundler [1994] "Studies on the nutrient uptake by the beet cyst nematode *Heterodera schachtii* by *in situ* microinjection of fluorescent probes into the feeding structures in *Arabidopsis thaliana*" *Parasitology* 109:249-254). This provides an excellent test system to screen RNAi molecules for efficacy by directly inhibiting growth and development of the nematode feeding upon the microinjected plant cell, or by reducing fecundity and the ability of said nematode to generate pathogenic or viable progeny.

[00040] There are a number of strategies that can be followed to assay for RNAi gene interference. Inhibition of gene expression by RNAi inhibits the accumulation of the corresponding secretory protein in the esophageal gland cells of transgenic J2 hatched from the eggs produced by the injected nematodes. In the first assay, polyclonal antibodies to the target gene product can be used in immunolocalization studies (Hussey, R. S. [1989] "Monoclonal antibodies to secretory granules in esophageal glands of *Meloidogyne* species" *J. Nematol.* 21:392-398; Borgonie, G, E. van Driessche, C. D. Link, D. de Waele, and A. Coomans [1994] "Tissue treatment for whole mount internal lectin staining in the nematodes *Caenorhabditis elegans*, *Panagrolaimus superbus* and *Acrobeloides maximus*" *Histochemistry* 101:379-384) to monitor the synthesis of the target protein in the gland cells of progeny of the injected nematodes, or in any other nematode tissue that fails to express the essential targeted gene. Interference of endogenous gene activity by the RNAi eliminates binding of the antibodies to secretory granules in the glands, or any other target tissue, of the transgenic nematodes, and can be monitored by these *in situ* hybridization experiments. Control nematodes injected only with the injection buffer can be processed similar to the RNAi treated nematodes.

[00041] Another assay is designed to determine the effect of the RNAi on reducing the virulence of J2 progeny of the injected females. Egg masses from injected females can be transferred singly to *A. thaliana* plates to assess the ability of the transgenic J2 to infect roots. The J2 hatching from the eggs transferred to the plates can be monitored; after 25 days the number of galls with egg laying females can be recorded. The *A. thaliana* roots can also be stained with acid fuchsin to enumerate the number of nematodes in the roots. Egg masses from nematodes injected only with the injection buffer can be handled similarly and used as controls. The treatments can be replicated, and the root infection data can be analyzed statistically. These experiments can be used to assess the importance of the target genes in root-knot nematode's virulence or viability. By staining the J2 progeny of the injected females with the antibodies, it can be determined whether RNAi blocks expression of the targeted gene.

[00042] Additional uses of polynucleotides. The polynucleotide sequences exemplified herein can be used in a variety of ways. These polynucleotides can be used in assays for additional polynucleotides and additional homologous genes, and can be used in tracking the quantitative and temporal expression of parasitism genes in nematodes. These polynucleotides can be cloned into microbes for production and isolation of their gene products. Among the many uses of the isolated gene product is the development of additional inhibitors and modifiers. The protein products of the subject polynucleotides can also be used as diagnostic tools. For example, proteins encoded by the parasitism genes, as identified herein, can be used in large scale screenings for additional peptide inhibitors. The use of peptide phage display screening is one method that can be used in this regard. Thus, the subject invention also provides new biotechnological strategies for managing nematodes under sustainable agricultural conditions.

[00043] Antisense technologies can also be used for phytopathogenic nematode control. Antisense technology can be used to interfere with expression of the disclosed endogenous nematode genes. Antisense technology can also be used to alter the components of plants used as targets by the nematodes. For example, the transformation of a plant with the reverse complement of an endogenous gene encoded by a polynucleotide exemplified herein can result in strand co-suppression and gene silencing

or inhibition of a target involved in the nematode infection process. Thus, the subject invention includes transgenic plants (which are preferably made nematode-resistant in this manner, and other organisms including microbes and phages) comprising RNAi or antisense molecules specific to any of the polynucleotides identified herein.

[00044] Polynucleotide probes. DNA possesses a fundamental property called base complementarity. In nature, DNA ordinarily exists in the form of pairs of anti-parallel strands, the bases on each strand projecting from that strand toward the opposite strand. The base adenine (A) on one strand will always be opposed to the base thymine (T) on the other strand, and the base guanine (G) will be opposed to the base cytosine (C). The bases are held in apposition by their ability to hydrogen bond in this specific way. Though each individual bond is relatively weak, the net effect of many adjacent hydrogen bonded bases, together with base stacking effects, is a stable joining of the two complementary strands. These bonds can be broken by treatments such as high pH or high temperature, and these conditions result in the dissociation, or "denaturation," of the two strands. If the DNA is then placed in conditions which make hydrogen bonding of the bases thermodynamically favorable, the DNA strands will anneal, or "hybridize," and reform the original double-stranded DNA. If carried out under appropriate conditions, this hybridization can be highly specific. That is, only strands with a high degree of base complementarity will be able to form stable double-stranded structures. The relationship of the specificity of hybridization to reaction conditions is well known. Thus, hybridization may be used to test whether two pieces of DNA are complementary in their base sequences. It is this hybridization mechanism which facilitates the use of probes of the subject invention to readily detect and characterize DNA sequences of interest.

[00045] The specifically exemplified polynucleotides of the subject invention can themselves be used as probes. Additional polynucleotide sequences can be added to the ends of (or internally in) the exemplified polynucleotide sequences so that polynucleotides that are longer than the exemplified polynucleotides can also be used as probes. Thus, isolated polynucleotides comprising one or more of the exemplified sequences are within the scope of the subject invention. Polynucleotides that have less nucleotides than the exemplified polynucleotides can also be used and are contemplated within the scope of the present invention. For example, for some purposes, it might be

useful to use a conserved sequence from an exemplified polynucleotide wherein the conserved sequence comprises a portion of an exemplified sequence. Thus, polynucleotides of the subject invention can be used to find additional, homologous (wholly or partially) genes.

[00046] Probes of the subject invention may be composed of DNA, RNA, or PNA (peptide nucleic acid). The probe will normally have at least about 10 bases, more usually at least about 17 bases, and may have about 100 bases or more. Longer probes can readily be utilized, and such probes can be, for example, several kilobases in length. The probe sequence is designed to be at least substantially complementary to a portion of a gene encoding a protein of interest. The probe need not have perfect complementarity to the sequence to which it hybridizes. The probes may be labeled utilizing techniques that are well known to those skilled in this art.

[00047] One approach for the use of the subject invention as probes entails first identifying DNA segments that are homologous with the disclosed nucleotide sequences using, for example, Southern blot analysis of a gene bank. Thus, it is possible, without the aid of biological analysis, to know in advance the probable activity of many new polynucleotides, and of the individual gene products expressed by a given polynucleotide. Such an analysis provides a rapid method for identifying commercially valuable compositions.

[00048] One hybridization procedure useful according to the subject invention typically includes the initial steps of isolating the DNA sample of interest and purifying it chemically. Either lysed nematodes or total fractionated nucleic acid isolated from nematodes can be used. Cells can be treated using known techniques to liberate their DNA (and/or RNA). The DNA sample can be cut into pieces with an appropriate restriction enzyme. The pieces can be separated by size through electrophoresis in a gel, usually agarose or acrylamide. The pieces of interest can be transferred to an immobilizing membrane.

[00049] The particular hybridization technique is not essential to the subject invention. As improvements are made in hybridization techniques, they can be readily applied.

[00050] The probe and sample can then be combined in a hybridization buffer solution and held at an appropriate temperature until annealing occurs. Thereafter, the membrane is washed free of extraneous materials, leaving the sample and bound probe molecules typically detected and quantified by autoradiography and/or liquid scintillation counting. As is well known in the art, if the probe molecule and nucleic acid sample hybridize by forming a strong non-covalent bond between the two molecules, it can be reasonably assumed that the probe and sample are essentially identical or very similar. The probe's detectable label provides a means for determining in a known manner whether hybridization has occurred.

[00051] In the use of the nucleotide segments as probes, the particular probe is labeled with any suitable label known to those skilled in the art, including radioactive and non-radioactive labels. Typical radioactive labels include ^{32}P , ^{35}S , or the like. Non-radioactive labels include, for example, ligands such as biotin or thyroxine, as well as enzymes such as hydrolases or peroxidases, or the various chemiluminescers such as luciferin, or fluorescent compounds like fluorescein and its derivatives. In addition, the probes can be made inherently fluorescent as described in International Application No. WO 93/16094.

[00052] Various degrees of stringency of hybridization can be employed. The more stringent the conditions, the greater the complementarity that is required for duplex formation. Stringency can be controlled by temperature, probe concentration, probe length, ionic strength, time, and the like. Preferably, hybridization is conducted under moderate to high stringency conditions by techniques well known in the art, as described, for example, in Keller, G.H., M.M. Manak (1987) *DNA Probes*, Stockton Press, New York, NY., pp. 169-170.

[00053] As used herein "moderate to high stringency" conditions for hybridization refers to conditions that achieve the same, or about the same, degree of specificity of hybridization as the conditions "as described herein." Examples of moderate to high stringency conditions are provided herein. Specifically, hybridization of immobilized DNA on Southern blots with ^{32}P -labeled gene-specific probes was performed using standard methods (Maniatis *et al.*). In general, hybridization and subsequent washes were carried out under moderate to high stringency conditions that

allowed for detection of target sequences with homology to sequences exemplified herein. For double-stranded DNA gene probes, hybridization was carried out overnight at 20-25° C below the melting temperature (T_m) of the DNA hybrid in 6X SSPE, 5X Denhardt's solution, 0.1% SDS, 0.1 mg/ml denatured DNA. The melting temperature is described by the following formula from Beltz *et al.* (1983):

[00054] $T_m = 81.5^\circ\text{C} + 16.6 \log[\text{Na}^+] + 0.41(\%G+C) - 0.61(\%\text{formamide}) - 600/\text{length of duplex in base pairs}.$

Washes are typically carried out as follows:

- (1) Twice at room temperature for 15 minutes in 1X SSPE, 0.1% SDS (low stringency wash).
- (2) Once at $T_m - 20^\circ\text{C}$ for 15 minutes in 0.2X SSPE, 0.1% SDS (moderate stringency wash).

[00055] For oligonucleotide probes, hybridization was carried out overnight at 10-20°C below the melting temperature (T_m) of the hybrid in 6X SSPE, 5X Denhardt's solution, 0.1% SDS, 0.1 mg/ml denatured DNA. T_m for oligonucleotide probes was determined by the following formula from Suggs *et al.* (1981):

[00056] $T_m (^\circ\text{C}) = 2(\text{number T/A base pairs}) + 4(\text{number G/C base pairs})$

[00057] Washes were typically carried out as follows:

- [00058] (1) Twice at room temperature for 15 minutes 1X SSPE, 0.1% SDS (low stringency wash).
- [00059] (2) Once at the hybridization temperature for 15 minutes in 1X SSPE, 0.1% SDS (moderate stringency wash).

[00060] In general, salt and/or temperature can be altered to change stringency. With a labeled DNA fragment of greater than about 70 or so bases in length, the following conditions can be used:

Low:	1 or 2X SSPE, room temperature
Low:	1 or 2X SSPE, 42°C
Moderate:	0.2X or 1X SSPE, 65°C
High:	0.1X SSPE, 65°C.

[00061] Duplex formation and stability depend on substantial complementarity between the two strands of a hybrid, and, as noted above, a certain degree of mismatch

can be tolerated. Therefore, polynucleotide sequences of the subject invention include mutations (both single and multiple), deletions, and insertions in the described sequences, and combinations thereof, wherein said mutations, insertions, and deletions permit formation of stable hybrids with a target polynucleotide of interest. Mutations, insertions, and deletions can be produced in a given polynucleotide sequence using standard methods known in the art. Other methods may become known in the future.

[00062] The mutational, insertional, and deletional variants of the polynucleotide sequences of the invention can be used in the same manner as the exemplified polynucleotide sequences so long as the variants have substantial sequence similarity with the original sequence. As used herein, substantial sequence similarity refers to the extent of nucleotide similarity that is sufficient to enable the variant polynucleotide to function in the same capacity as the original sequence. Preferably, this similarity is greater than 50%; more preferably, this similarity is greater than 75%; and most preferably, this similarity is greater than 90%. The degree of similarity needed for the variant to function in its intended capacity will depend upon the intended use of the sequence. It is well within the skill of a person trained in this art to make mutational, insertional, and deletional mutations that are designed to improve the function of the sequence or otherwise provide a methodological advantage.

[00063] PCR technology. Polymerase Chain Reaction (PCR) is a repetitive, enzymatic, primed synthesis of a nucleic acid sequence. This procedure is well known and commonly used by those skilled in this art (see U.S. Patent Nos. 4,683,195; 4,683,202; and 4,800,159; Saiki *et al.*, 1985). PCR is based on the enzymatic amplification of a DNA fragment of interest that is flanked by two oligonucleotide primers that hybridize to opposite strands of the target sequence. The primers are oriented with the 3' ends pointing towards each other. Repeated cycles of heat denaturation of the template, annealing of the primers to their complementary sequences, and extension of the annealed primers with a DNA polymerase result in the amplification of the segment defined by the 5' ends of the PCR primers. Since the extension product of each primer can serve as a template for the other primer, each cycle essentially doubles the amount of DNA fragment produced in the previous cycle. This results in the exponential accumulation of the specific target fragment, up to several million-fold in a

few hours. By using a thermostable DNA polymerase such as *Taq* polymerase, which is isolated from the thermophilic bacterium *Thermus aquaticus*, the amplification process can be completely automated. Other enzymes that can be used are known to those skilled in the art.

[00064] The polynucleotide sequences of the subject invention (and portions thereof such as conserved regions and portions that serve to distinguish these sequences from previously-known sequences) can be used as, and/or used in the design of, primers for PCR amplification. In performing PCR amplification, a certain degree of mismatch can be tolerated between primer and template. Therefore, mutations, deletions, and insertions (especially additions of nucleotides to the 5' end) of the exemplified polynucleotides can be used in this manner. Mutations, insertions and deletions can be produced in a given primer by methods known to an ordinarily skilled artisan.

[00065] The polynucleotide sequences of the instant invention may be "operably linked" to regulatory sequences such as promoters and enhancers. Nucleic acid is "operably linked" when it is placed into a functional relationship with another nucleic acid sequence. For example, DNA for a presequence or secretory leader is "operably linked" to DNA encoding a polypeptide if it is expressed as a preprotein that participates in the secretion of the polypeptide; a promoter or enhancer is "operably linked" to a coding sequence if it affects the transcription of the sequence; or a ribosome binding site is "operably linked" to a coding sequence if it is positioned so as to facilitate translation. Generally, "operably linked" means that the DNA sequences being linked are contiguous, and, in the case of a secretory leader, contiguous and in reading phase. However, enhancers do not have to be contiguous. Linking is accomplished by ligation at convenient restriction sites. If such sites do not exist, synthetic oligonucleotide adaptors or linkers are used in accordance with conventional practice.

[00066] Polynucleotides and proteins. Polynucleotides of the subject invention can be defined according to several parameters. One characteristic is the biological activity of the protein products as identified herein. The proteins and genes of the subject invention can be further defined by their amino acid and nucleotide sequences. The sequences of the molecules can be defined in terms of homology to certain exemplified sequences as well as in terms of the ability to hybridize with, or be amplified by, certain

exemplified probes and primers. Additional primers and probes can readily be constructed by those skilled in the art such that alternate polynucleotide sequences encoding the same amino acid sequences can be used to identify and/or characterize additional genes. The proteins of the subject invention can also be identified based on their immunoreactivity with certain antibodies.

[00067] The polynucleotides and proteins of the subject invention include portions, fragments, variants, and mutants of the full-length sequences as well as fusions and chimerics, so long as the encoded protein retains the characteristic biological activity of the proteins identified herein. As used herein, the terms "variants" or "variations" of genes refer to nucleotide sequences that encode the same proteins or which encode equivalent proteins having equivalent biological activity. As used herein, the term "equivalent proteins" refers to proteins having the same or essentially the same biological activity as the exemplified proteins.

[00068] It will be apparent to a person skilled in this art that genes within the scope of the subject invention can be identified and obtained through several means. The specific genes exemplified herein may be obtained from root-knot nematodes. Genes, or portions or variants thereof, may also be artificially synthesized by, for example, a gene synthesizer.

[00069] Variations of genes may be readily constructed using standard techniques such as site-directed mutagenesis and other methods of making point mutations and by DNA shuffling, for example. In addition, gene and protein fragments can be made using commercially available exonucleases, endonucleases, and proteases according to standard procedures. For example, enzymes such as *Bal31* can be used to systematically cut off nucleotides from the ends of genes. In addition, genes that encode fragments may be obtained using a variety of restriction enzymes. Proteases may be used to directly obtain active fragments of these proteins. Of course, molecular techniques for cloning polynucleotides and producing gene constructs of interest are also well known in the art. *In vitro* evaluation techniques, such as MAXYGEN's "Molecular Breeding" can also be applied to practice the subject invention.

[00070] Other molecular techniques can also be applied using the teachings provided herein. For example, antibodies raised against proteins encoded by

polynucleotides disclosed herein can be used to identify and isolate proteins from a mixture of proteins. Specifically, antibodies may be raised to the portions of the proteins that are conserved and most distinct from other proteins. These antibodies can then be used to specifically identify equivalent proteins by immunoprecipitation, enzyme linked immunosorbent assay (ELISA), or Western blotting. Antibodies to proteins encoded by polynucleotides disclosed herein, or to equivalent proteins, can readily be prepared using standard procedures known in the art. The genes that encode these proteins can be obtained from various organisms.

[00071] Because of the redundancy of the genetic code, a variety of different DNA sequences can encode the amino acid sequences encoded by the polynucleotide sequences disclosed herein. It is well within the skill of a person trained in the art to create these alternative DNA sequences encoding proteins having the same, or essentially the same, amino acid sequence. These variant DNA sequences are within the scope of the subject invention. As used herein, reference to "essentially the same" sequence refers to sequences that have amino acid substitutions, deletions, additions, or insertions that do not materially affect biological activity. Fragments retaining the characteristic biological activity are also included in this definition.

[00072] A further method for identifying genes and polynucleotides (and the proteins encoded thereby) of the subject invention is through the use of oligonucleotide probes. Probes provide a rapid method for identifying genes of the subject invention. The nucleotide segments that are used as probes according to the invention can be synthesized using a DNA synthesizer and standard procedures.

[00073] The subject invention comprises variant or equivalent proteins (and nucleotide sequences coding for equivalent proteins or for inhibitors of the genes encoding such proteins) having the same or similar biological activity of inhibitors or proteins encoded by the exemplified polynucleotides. Equivalent proteins will have amino acid similarity with an exemplified protein (or peptide). The amino acid and/or nucleotide identity will typically be greater than 60%. Preferably, the identity will be greater than 75%. More preferably, the identity will be greater than 80%, and even more preferably greater than 90%. Most preferably, the identity will be greater than 95%. RNAi molecules will also have corresponding identities in these preferred ranges. These

identities are as determined using standard alignment techniques for determining amino acid and/or nucleotide identity. The identity/similarity will be highest in critical regions of the protein or gene including those regions that account for biological activity or that are involved in the determination of three-dimensional configuration that is ultimately responsible for the biological activity. In this regard, certain amino acid substitutions are acceptable and can be expected if these substitutions are in regions which are not critical to activity or are conservative amino acid substitutions which do not affect the three-dimensional configuration of the molecule. For example, amino acids may be placed in the following classes: non-polar, uncharged polar, basic, and acidic. Conservative substitutions whereby an amino acid of one class is replaced with another amino acid of the same type fall within the scope of the subject invention so long as the substitution does not materially alter the biological activity of the compound. Below is a list of examples of amino acids belonging to various classes

Class of Amino Acid	Examples of Amino Acids
Nonpolar	Ala, Val, Leu, Ile, Pro, Met, Phe, Trp
Uncharged Polar	Gly, Ser, Thr, Cys, Tyr, Asn, Gln
Acidic	Asp, Glu
Basic	Lys, Arg, His

[00074] In some instances, non-conservative substitutions can also be made. The critical factor is that these substitutions must not detract from the ability to manage nematode-caused diseases.

[00075] An "isolated" or "substantially pure" nucleic acid molecule or polynucleotide is a polynucleotide that is substantially separated from other polynucleotide sequences which naturally accompany a nucleic acid molecule. The term embraces a polynucleotide sequence which was removed from its naturally occurring environment by the hand of man. This includes recombinant or cloned DNA isolates,

chemically synthesized analogues and analogues biologically synthesized by heterologous systems. An "isolated" or "purified" protein, likewise, is a protein removed from its naturally occurring environment.

[00076] Recombinant hosts. The genes, antisense, and RNAi polynucleotides within the scope of the present invention can be introduced into a wide variety of microbial or plant hosts. Plant cells can be transformed (made recombinant) in this manner. Microbes, for example, can also be used in the application of RNAi molecules of the subject invention in view of the fact that microbes are a food source for nematodes

[00077] There are many methods for introducing a heterologous gene or polynucleotide into a host cell or cells under conditions that allow for stable maintenance and expression of the gene or polynucleotide. These methods are well known to those skilled in the art. Synthetic genes, such as, for example, those genes modified to enhance expression in a heterologous host (such as by preferred codon usage or by the use of adjoining, downstream, or upstream enhancers) that are functionally equivalent to the genes (and which encode equivalent proteins) can also be used to transform hosts. Methods for the production of synthetic genes are known in the art.

[00078] Where the gene or polynucleotide of interest is introduced via a suitable vector into a microbial host, and said host is applied to the environment in a living state, certain host microbes are preferred. Certain microorganism hosts are known to occupy the phytosphere, phylloplane, phyllosphere, rhizosphere, and/or rhizoplane of one or more crops of interest. These microorganisms can be selected so as to be capable of successfully competing in the particular environment (crop and other habitats) with the wild-type microorganisms, provide for stable maintenance and expression of the gene expressing a polypeptide of interest, and, desirably, provide for improved protection of the protein/peptide from environmental degradation and inactivation.

[00079] A large number of microorganisms is known to inhabit the phylloplane (the surface of the plant leaves) and/or the rhizosphere (the soil surrounding plant roots) of a wide variety of important crops. These microorganisms include bacteria, algae, and fungi. Of particular interest are microorganisms, such as bacteria, *e.g.*, genera *Pseudomonas*, *Erwinia*, *Serratia*, *Klebsiella*, *Xanthomonas*, *Streptomyces*, *Rhizobium*, *Rhodopseudomonas*, *Methylophilus*, *Agrobacterium*, *Acetobacter*, *Lactobacillus*,

Arthrobacter, *Azotobacter*, *Leuconostoc*, and *Alcaligenes*; fungi, particularly yeast, *e.g.*, genera *Saccharomyces*, *Cryptococcus*, *Kluyveromyces*, *Sporobolomyces*, *Rhodotorula*, and *Aureobasidium*. Of particular interest are the pigmented microorganisms.

[00080] Methods of the subject invention also include the transformation of plants or plant tissue with genes which encode the RNAi molecules of the present invention. In one embodiment, the transformed plant or plant tissue expresses antisense RNA and/or RNAi. Transformation of cells can be made by those skilled in the art using standard techniques. Materials necessary for these transformations are disclosed herein or are otherwise readily available to the skilled artisan.

[00081] Additional methods and formulations for control of pests. Control of nematode pests using the RNAi molecules of the instant invention can be accomplished by a variety of additional methods that would be apparent to those skilled in the art having the benefit of the subject disclosure. A "cocktail" of two or more RNAi molecules can be used to disrupt one or more of the genes identified herein. The "cocktail" of RNAi molecules may be specific to segments of a single gene or the entire gene. A "multigene cocktail" of RNAi molecules specific to two or more genes (or segments thereof) is also encompassed by the instant invention. In another embodiment of the instant invention, the disclosed RNAi molecules, cocktails, and/or multigene cocktails thereof, may be used in conjunction with other known nematode control agents and methodologies. Such cocktails can be used to combat the development of resistance by nematodes to a certain inhibitor or inhibitors.

[00082] Compositions of the subject invention which comprise RNAi molecules and carriers can be applied, themselves, directly or indirectly, to locations frequented by, or expected to be frequented by, nematodes. Microbial hosts which were transformed with polynucleotides that encode RNAi molecules, express said RNAi molecules, and which colonize roots (*e.g.*, *Pseudomonas*, *Bacillus*, and other genera) can be applied to the sites of the pest, where they will proliferate and be ingested. The result is control of the pest. Thus, methods of the subject invention include, for example, the application of recombinant microbes to the pests (or their locations). The recombinant microbes may also be transformed with more than one RNAi molecule thereby delivering a "cocktail" of RNAi molecules to the nematode pests. A carrier may be any substance suitable for

delivering the RNAi molecules to the nematode. Acceptable carriers are well known in the art and also are commercially available. For example, such acceptable carriers are described in E.W. Martin's *Remington's Pharmaceutical Science*, Mack Publishing Company, Easton, PA.

[00083] All patents, patent applications, provisional applications, and publications referred to or cited herein are incorporated by reference in their entirety to the extent they are not inconsistent with the explicit teachings of this specification.

[00084] Following are examples that illustrate procedures for practicing the invention. These examples should not be construed as limiting. All percentages are by weight and all solvent mixture proportions are by volume unless otherwise noted.

Example 1— Production of Hairy Roots for RNAi Testing

[00085] A hairy root assay system was developed for testing the anti-nematode activity of RNAi molecules.

[00086] *Agrobacterium rhizogenes*: Several *Agrobacterium rhizogenes* strains produce hairy roots on a variety of plant species. *A. rhizogenes* strains, A4, 15834, 8196 and LBA4404 demonstrate hairy root development on tomato and sugar beet, with A4 being the most efficient. The *A. rhizogenes* strain K599 demonstrated very efficient formation on transgenic soybean hairy roots and was also effective on sugar beet and *Arabidopsis*. However, strain K599 failed to produce hairy roots on tomato tissues possibly due to hyper-virulence.

[00087] Hairy root production: Transgenic hairy roots were identified by stable GUS expression in tomato, sugar beet, soybean and *Arabidopsis*. The construct pAKK1401 (pNOS / NPT-II / tNOS // pSU / GUS / tNOS) was used to produce hairy roots when transformed into *A. rhizogenes* strains A4 or K599. Transgenic roots were identified by GUS expression.

Example 2 — Protocol for Electro-competent *Agrobacterium* and Electroporation

[00088] Electro-competent *Agrobacterium* Protocol:

- [00089] 1. Grow *Agrobacterium* overnight in 5 mls LB + antibiotics at 30°C on shaker (for *Agrobacterium rhizogenes* strain K599 no antibiotics are needed).
- [00090] 2. Use the 5 mls of overnight culture to inoculate 500 mls LB + antibiotics at 30°C on shaker. Grow overnight.
- [00091] 3. Add liquid culture in eight 50 ml polypropylene orange cap tubes.
- [00092] 4. Centrifuge 10 min., 4000 rpm, 4°C.
- [00093] 5. Resuspend cells in each tube with 20 mls 10% glycerol (on ice)
- [00094] 6. Centrifuge 10 min., 4000 rpm, 4°C.
- [00095] 7. Resuspend cells in each tube with 10 mls 10% glycerol (on ice).
- [00096] 8. Centrifuge 10 min., 4000 rpm, 4°C.
- [00097] 9. Resuspend cells in each tube with 2 mls 10% glycerol (on ice).
- [00098] 10. Aliquot 50 µl into cold Eppendorf tube and place onto dry ice.
- [00099] 11. Store electro-competent cells at -80°C. These cells can be used for up to two years.

[000100] Electroporations:

- [000101] 1. Add 1 µl to 5 µl of DNA (resuspended in H₂O and not TE or other buffer) to 50 µl of *Agrobacterium* electrocompetent cells and mix.
- [000102] 2. Transfer 20 µl of DNA/*Agrobacterium* mix to cuvette.
- [000103] 3. Electroporate:
25µF, 400 Ω resistance, 2.5 volts (0.2cm cuvette) or 1.8 volts (0.1cm cuvette for BioRad electroporator. 330 µF, 4000 kΩ, low w, fast charge rate for BRL Electroporator.
- [000104] 4. Add 1ml of LB and transfer to Eppendorf tube.
- [000105] 5. Shake at 30°C for 2 hours.
- [000106] 6. Centrifuge down cells (2 min. 14 krpm).
- [000107] 7. Plate all onto LB + antibiotics (most *Agrobacterium* strains are naturally streptomycin resistant).

Example 3 – Protocol for Production of Transgenic Hairy Roots on Soybean

[000108] Seed Sterilization. Rinse the soybean seed with 70% ETOH for 2-5 min. Remove and add 20% Clorox and shake for 20-25 min. Rinse 3X with sterile water. Plate the seed, 5 seed per plate, onto ½ MSB5 + 2% sucrose + 0.2% gel (referred to as ½ MSB5). Place seed into chamber at 25C, 16/8 photoperiod for 5-7 day (depending on genotype) germination period. After 1 week seedlings can be placed into cold room for longer storage if necessary (not to exceed 2 weeks).

[000109] Agrobacterium Preparation. For *Agrobacterium rhizogenes* strain K599, take a small sample from frozen glycerol into 25-50 ml of NZYM media with 50 mg/L kanamycin in a 125-250 ml Erlenmyer flask. Place onto shaker at 28-30 °C for 16 - 20 hours. Pour sample into centrifuge tube and centrifuge the bacterium at 4000 rpm for 10 min. Pour off supernatant and re-suspend the pellet with an equal volume of liquid ½ MSB5 + 200 µM acetosyringone. Use pipette to re-suspend the pellet and homogenize the sample (remove all clumps). To determine O.D., prepare a 1:10 dilution by putting 900 µl ½ MSB5 into cuvette and add 100 µl of bacterial sample. Determine the O.D.₆₆₀ and calculate the volume needed to adjust (dilute) OD to approximately 0.2 for inoculation. Check final O.D.

[000110] Explant Preparation and inoculation. Place a sterile filter paper onto plates of 1/2 MSB5. Cut soybean cotyledons just above the shoot apex and place onto plate. Lightly scar the cotyledon's abaxial surface (flat side, upper surface that reaches toward sun) with a scalpel blade. Cut each cotyledon transversely into 2-3 pieces (no smaller than 1 cm). Add approximately 10 ml of prepared bacterial solution to each plate and allow cotyledons to incubate for 1 hr. Remove the bacteria using a vacuum aspirator fitted with sterile pipette tip, ensure that there is no standing liquid. Orient all explants with abaxial surface up and wrap plates for a 3 day co-culture, 25°C in light (16/8 photoperiod).

[000111] Hairy root selection and maintenance. After 3 day co-culture, wash explants with liquid ½ MSB5 + 500 mg/L carbenicillin. Transfer the explants abaxial side up to selection media, ½ MSB5 supplemented with 500 mg/L carbenicillin and 200 mg/L kanamycin. Roots should develop in approximately 2-3 weeks. The roots will form primarily from the cut vascular bundles with other roots developing from the small cuts on cotyledon surface. Remove roots (>1cm in length) and place onto replica media with

transfers to fresh media every 2 weeks to prevent *Agrobacterium* overgrowth. After 6-8 weeks on selection the roots can be moved to media without kanamycin, however carbenicillin must remain in media for several months for continued suppression of *Agrobacterium*. At this stage roots can be used for testing RNAi for nematode control. Sterilized nematodes can be added and observed for RNAi affects.

Example 4 – Testing of RNAi for Plant Parasitic Nematode Control.

[000112] Various types of nematodes can be used in appropriate bioassays. For example, *Caenorhabditis elegans*, a bacterial feeding nematode, and plant parasitic nematodes can be used for bioassay purposes. Examples of plant parasitic nematodes include a migratory endo-parasite, *Pratylenchus scribneri* (lesion), and two sedentary endo-parasites, *Meloidogyne javanica* (root-knot) and *Heterodera schachtii* (cyst).

[000113] *C. elegans*: RNAi vectors can be tested through expression of the RNAi in *E. coli*. *C. elegans* are fed *E. coli* and assayed for their growth by measuring growth of nematodes, production of eggs and viability of offspring. Another approach is to inject dsRNA directly into living nematodes. Finally, soaking nematodes in a solution of *in vitro*-prepared RNAi can quickly establish efficacy of treatment.

[000114] *P. scribneri*: The *P. scribneri in vitro* feeding assay uses a corn root exudate (CRE) as a feeding stimulus and both the red dye Amaranth or potassium, arsenate as feeding indicators. Feeding is confirmed after seven days by the presence of red stained intestinal cells in live worms exposed to the Amaranth or death of worms exposed to arsenate. This bioassay is used to test soluble toxins or RNAi. *P. scribneri* has also been cultured on wild type roots of corn, rice and *Arabidopsis*, and on A. rhizogenes-induced hairy roots of sugar beet and tomato. *P. scribneri* is very valuable in evaluating transgenic hairy roots because of the non-specific feeding of these worms.

[000115] *M. javanica*: Nematode eggs are sterilized using bleach and are used to inoculate hairy roots expressing RNAi. Nematodes are assessed for their growth by measuring knots, egg masses or production of viable eggs. An alternative approach is to microinject dsRNA directly into root feeding sites or into living female nematodes.

[000116] *H. schachtii*: Cultures of this nematode were maintained on sugar beets. Nematodes eggs are sterilized using bleach and used to inoculate hairy roots

expressing RNAi. Nematodes can be assessed for their growth by measuring knots, egg masses or production of viable eggs.

Example 5 – Plant Expression Vectors for RNAi

[000117] Modular Binary Construct System (MBCS): An important aspect of the subject disclosure is the Modular Binary Construct System. The MBCS eases the burden of construct development by creating modular pieces of DNA that can be easily added, removed, or replaced with the use of low frequency cutting restriction enzymes (8-base cutters). These constructs are useful for delivery of a variety of genes to plant cells and is not limited to the delivery of RNAi genes. To develop this system, a series of six, 8-base cutter restriction enzyme sites was placed between the left and right Ti borders of a previously created $\text{kan}^R/\text{tet}^R$ binary plasmid (Figure 1). The production of both kan^R and tet^R MCBS aids the testing of constructs using different strains of *Agrobacterium rhizogenes* in different plant species. In addition to the MBCS, a series of shuttle vectors were created that aid in the cloning of useful DNA fragments by containing the multi-cloning site (MCS) of a modified Bluescript plasmid flanked by 8-base restriction sites (Figure 2). With six 8-base cutter sites, each site is, preferably, reserved for a particular function (Figures 3 and 4). Because of the close proximity of the *Pme* I and *Sgf*I sites to the left and right border of the binary vector, these sites are, preferably, reserved for gene tagging and enhancer trap experiments. The *Not* I site is, preferably, reserved for plant selectable markers (Figure 5). The *Pac* I site is reserved, preferably, for Plant Scorable Markers (Figure 6). The *Asc* I site is, preferably, reserved for RNAi experiments (Figures 7 and 8), while the *Sbf*I site is, preferably, reserved for anti-nematode proteins. The restriction sites that are denoted in the Figures are, preferably, reserved for the denoted insertions; however, the MCBS binary and shuttle vectors do not require the restriction sites to contain these suggested inserts.

[000118] Plant Selectable Markers for MBCS: To further develop the MBCS, a series of plant selectable markers were added to the MBCS (Figure 5). Plant selectable markers that were added to the MBCS include: pNOS/NPT-II/tNOS (kan^R), pNOS/Bar/tNOS (basta^R for dicots), pUBI/Intron-Bar/tNOS (basta^R for monocots), and pUBI/Intron-PMI/tNOS (mannitol isomerase R).

[000119] Reporter Genes for MBCS: Four exemplary reporter genes are used in the MBCS are provided in Figure 6 and Appendix 2. GUS, a nuclear localized GUS, GFP, and the anthocyanin transcriptional activator *papIC* genes into the MBCS.

[000120] Promoters for MBCS: We cloned several useful constitutive and nematode-inducible promoters (Figures 6, 7 and Appendix 2). Constitutive promoters include the SuperUbiquitin promoter from pine (pSU) and two promoter regions from the Strawberry Banding Vein virus (pSBV₁ and pSBV₂). Seven nematode-inducible promoters from *Arabidopsis* were also been cloned.

[000121] The following Scorable marker clones have been constructed and placed in the MBCS, NPT-II binary vector (pNOS/NPT-II/tNOS):

Intron/GUS/tNOS	Intron/NLS-GUS/tNOS	Intron/GFP/tNOS
pSU/Intron/GUS/tNOS	pSU/Intron/NLS-GUS/tNOS	pSU/Intron/GFP/tNOS
pSBV ₁ /Intron/GUS/tNOS	pSBV ₁ /Intron/NLS-GUS/tNOS	pSBV ₁ /Intron/GFP/tNOS
pSBV ₂ /Intron/GUS/tNOS	pSBV ₂ /Intron/NLS-GUS/tNOS	pSBV ₂ /Intron/GFP/tNOS
pKT/Intron/GFP/tNOS		
pKA/Intron/GFP/tNOS		

Example 6 – Control of Plant parasitic nematodes using RNAi in planta

[000122] Production of RNAi Vector. The RNAi shuttle vector to be used is adapted from the Modular Binary Construct System (MBCS - See Example 5). RNAi shuttle vectors preferably comprise a promoter, intron, antisense RNAi, stuffer fragment, sense RNAi, and terminator (See Figures 7 and 8 and Appendix 2 for more details). The plant promoter can be constitutive, tissue-specific or nematode-inducible. The intron is necessary to eliminate expression in *Agrobacterium*.

[000123] The anti-sense and sense RNAi molecules comprise nematode-specific sequences and are disclosed herein. These genes are associated with pathogenesis, growth, or other cellular function in nematodes. An exemplary group of RNAi sequences for use in plant/nematode control may be based upon:

[000124] 1. Genes specific for nematode esophageal gland cells.

[000125] 2. Genes specific for plant parasitic nematodes but not other free living nematodes.

- [000126] 3. Genes common to all plant parasitic nematodes.
- [000127] 4. Genes common to all nematodes (nematode-specific).
- [000128] 5. Genes specific for important tissues or cell types.
- [000129] 6. Genes from large gene families.
- [000130] 7. Genes involved in nematode signal transduction or other cellular pathways.

[000131] Appropriate RNAi constructs allow for the formation of dsRNA molecules (the sense and antisense strands join to form the dsRNA). The terminator sequence adds a poly-A tail for transcriptional termination. The RNAi shuttle vector can then be subcloned into the MBCS and transformed into *Agrobacterium rhizogenes*.

[000132] Plant Transformation with RNAi Vectors. An exemplary transformation system for generating hairy roots using *Agrobacterium rhizogenes* is provided below. The RNAi vector once introduced into the MBCS can subsequently (as a binary vector) be transformed in *A. rhizogenes* using, for example, the electroporation protocol of Example 2. Once the *A. rhizogenes* is confirmed to contain the plasmid, it is then used in generating hairy roots (See Example 3). Using this protocol transgenic hairy roots expressing RNAi are isolated, cultured and tested.

[000133] Testing of RNAi Vector for Nematode or Plant Pathogen Resistance. RNAi expressing hairy roots can be inoculated with sterilized nematodes. Infested hairy roots can be observed and the effect on nematodes determined. An alternative approach involves the microinjection of RNAi directly into root feeding sites (giant-cells for root-knot nematode, and syncytia for cyst nematodes) or into living female nematodes.

Example 7 – Insertion of Genes Into Plants

[000134] One aspect of the subject invention is the transformation of plants with genes encoding proteins of the present invention. Transformation of plants as described herein can be used to improve the resistance of these plants to attack by the target pest.

[000135] Genes, polynucleotides, and/or RNAi molecules as disclosed or suggested herein can be inserted into plant cells using a variety of techniques which are

well known in the art. For example, a large number of cloning vectors, for example, pBR322, pUC series, M13mp series, pACYC184, pMON, *etc.*, are available for preparation for the insertion of foreign genes into higher plants via injection, biolistics (microparticle bombardment), *Agrobacterium tumefaciens*, or *Agrobacterium rhizogenes*-mediated transformation, or electroporation as well as other possible methods. Once the inserted DNA has been integrated into the genome, the genetically modified-cell(s) can be screened via a vector carried-selectable marker that confers on the transformed plant cells resistance to a biocide or an antibiotic, such as kanamycin, G418, bleomycin, hygromycin, chloramphenicol, or bialaphos, *inter alia*. The transformed cell will be regenerated into a morphologically normal plant. The transgene(s) in the transgenic plant is relatively stable and can be inherited by progeny plants.

[000136] If a transformation event involves a germ line cell, then the inserted DNA an corresponding phenotypic trait(s) will be transmitted to progeny plants. Such plants can be grown in the normal manner and crossed with plants that have the same transformed hereditary factors or other hereditary factors. The resulting hybrid individuals have the corresponding phenotypic properties.

[000137] It should be understood that the examples and embodiments described herein are for illustrative purposes only and that various modifications or changes in light thereof will be suggested to persons skilled in the art and are to be included within the spirit and purview of this application.

We claim:

1. An RNAi molecule, optionally comprising a linker, wherein at least one strand of said RNAi is encoded by a DNA sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 139.

2. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

1.

3. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

2.

4. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

3.

5. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

4.

6. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

5.

7. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

6.

8. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

7.

9. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

8.

10. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

9.

10. 11. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
11. 12. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
12. 13. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
13. 14. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
14. 15. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
15. 16. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
16. 17. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
17. 18. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
18. 19. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
19. 20. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
20. 21. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

21. 22. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
22. 23. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
23. 24. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
24. 25. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
25. 26. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
26. 27. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
27. 28. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
28. 29. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
29. 30. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
30. 31. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
31. 32. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

34

32. 33. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
33. 34. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
34. 35. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
35. 36. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
36. 37. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
37. 38. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
38. 39. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
39. 40. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
40. 41. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
41. 42. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
42. 43. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

43. 44. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
44. 45. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
45. 46. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
46. 47. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
47. 48. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
48. 49. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
49. 50. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
50. 51. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
51. 52. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
52. 53. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
53. 54. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

54. 55. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
55. 56. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
56. 57. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
57. 58. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
58. 59. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
59. 60. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
60. 61. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
61. 62. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
62. 63. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
63. 64. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
64. 65. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

65. 66. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
66. 67. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
67. 68. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
68. 69. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
69. 70. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
70. 71. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
71. 72. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
72. 73. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
73. 74. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
74. 75. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
75. 76. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

76. 77. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
77. 78. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
78. 79. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
79. 80. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
80. 81. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
81. 82. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
82. 83. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
83. 84. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
84. 85. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
85. 86. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
86. 87. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

87. 88. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
88. 89. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
89. 90. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
90. 91. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
91. 92. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
92. 93. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
93. 94. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
94. 95. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
95. 96. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
96. 97. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:
97. 98. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO:

110. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 109.

111. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 110.

112. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 111.

113. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 112.

114. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 113.

115. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 114.

116. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 115.

117. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 116.

118. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 117.

119. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 118.

120. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 119.

121. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 120.

122. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 121.

123. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 122.

124. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 123.

125. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 124.

126. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 125.

127. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 126.

128. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 127.

129. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 128.

130. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 129.

131. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 130.

132. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 131.

133. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 132.

134. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 133.

135. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 134.

136. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 135.

137. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 136.

138. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 137.

139. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 138.

140. An RNAi molecule according to claim 1, wherein said DNA sequence is SEQ ID NO: 139.

141. A transgenic plant or transgenic plant tissue comprising an RNAi molecule according to any of the preceding claims.

142. A method of disrupting cellular processes in a nematode comprising the steps of:

(a) providing a composition comprising a compound according to any of the preceding claims; and

(b) contacting a nematode with said composition.

143. An isolated promoter comprising the following nucleotide sequence:

aacagcccaagataaacagaaaagtcaaagggtgttcgaaa
gaccacttgtgactaaggatcatttcacataattatctggtagca
cagactcatgataaetgcgaggaacacaagttctttacagtcgattc
aaagacactttctctttacggtttcattgaaggagccgacccagaat
atgtcagagaagcttttcactgtgggttaatttcattaatctatcca
ggtgaaaacctcaaggagatctctcttctcccaaaagacctctacag
ggcaatcaaaaactacagaaccagagtttgtagtgacacagagtagac
caatctacctgagaatcacgagtaccttcctagagtgggaaaatgat
gacatccttattccataccactggattgaggtaggactatccaatgg
aaaaattccatgggacaagtcataataagaagaccgcaacagtcgagt
atcttccagagataactgcactcagacctaaaaggataaaaagcagta
tataatcagtgtactaagatcttcgcagattcaaagaagaagcttaa
ctatgctgatgacaagataattctaataagcaattattcagaattaa
tcaaggagaaagaattaataactctttcagaatatgaagcccgttt
acaagtggccagctagctatcactgaaaagacagcaagacaatggtg
tctcgatgcaccagaaccacatctttgcagcagatgtgaagcagcca
gagtgggtccacaagacgcactcagaaaaggcatcttctaccgacaca
gaaaaagacaaccacagctcatcatccaacatgtagactgtcgttat
gcgtcggctgaagataagactgaccccaggccagcactaaagaagaa
ataatgcaagtggctcctagctccacttttagctttaataattatgttt
cattattattctctgcttttgctctctatataaagagcttgatattt
catttgaggcagaggcgcaacacacacagaacctccctgcttaca
aacatgtattgtagctaaacctcttaggag.

144. An isolated promoter comprising the following nucleotide sequence:

tggtggggacaatggatccggtctgcgtagcaacaaggctg
aaaaagattaaacagaaacctgtgatcattagcgttggaccaccacc
aaaacctcctgagccaccaaacgctccagagcctgaaaaaccaaagc
ctccaccagcacctgaaccaccaaacgcatgtatgcaagccaccttac
tgcaacagttgtgatgttgtgtctgttactacctatgaaagtggaag
cggctgcaccattctttgagtcataatcgcgtagcatagccttcac
gttaagtccgtgatttagccaataactaattcatcatgtttctcatgct
tttttgtttattttctttttctcaaatatgaatctctgtttgtttgtcc
ctccctgtttataattagtcgcttctttgacacaagaagtctcatg
agttcatgctaagaaaaataaaagtccaattaaaaacaccaaagtgtt
tgattaatctccataaacctgtgaagcagaaagttagtcatgttgac
ctgaacagagccttaggaagtccttgaaggacatatcttcaagtgtcta
ttgggtcgtagcactcttaggccatttaacttcattgagcccattaa
attatgcaaaacaagaaatgagacatatggaaacattagggttctta
caggaaaaaataggaaaaagcagggacaactaaacaaaaattcagaa
acaagaggcaagtggacgaccacggcgtaagatcaacatgtggtgat
gtgcatgagaccaagaccattttttctcggtcttcaacgcacacttg
gtcttttcttatgtttgttgcatcttctttattaggcagaccctctct
cttttttaatataggatagtaaaaaatatatgattttattttgttgaaa
cattttgagttaaaacctaaacttatagtaagcattttagtagagtga
tttctctatacgacatctatcaacatgaccttaacaaaaaaatatt
gatgaaactactttaagtagtaaaacctaaagcaattaaaatttct
ttaaattagtagtttgtgtaaattaattgacatgattgcgtcgaaag
aatcaaaacagttatatcggtgaacttaggagaatgttttatatcgt
gtttcaacacatgattgctagcatatgtgtaggtgtcgtagacgtta
cataacaatcatcactcgtaaatatcaaagtggtttctgagagaaac
aaagggttatgattttcccaactgcactagttgtgtattgtttcttt
cacacgtatgcttctgagttctgcccacaaagtggaaattaaagcagag
ttgggagagatcataatttattaggggtcggttatgctcaagtcatga
cgtaaaatgaaaatttgtttttattctttcaccaacacaaagaatag
ctagttatctctttttttatatataacaattcatgaagttgatcagc
tttatacacatcatccaatcgaattgctaattctagagatggaaatat
caggatagagccaataagatatcaaactcaatggaccattttctcc
atgtgctaattcatacaatctgtttttgtctgctttattttgatgatg
atgctgagcgtttttaagtgtgaactaagatctagctaaccaaaaca
aagatggctctcttctgtctttgtcgatataagagcaagagagtggttt
gattcaatttttaaaattctaaataaaaactccaaccgtgaatccagc
catgaaactctttttagaaaatccttttttataacaaataattctct
tgcttcttcttcttcttctgtttattttcaccttttttggtttctttag
ctcagaaaaagccattctttttttctattcttgtttatttttaatca
tactgtgcgtttctacaaagttgttcctttcttcttcaactctctc
actcacagtcacagagatctgtttctttttcttttttgctttcactc
ttctcttccagt.

145. An isolated promoter comprising the following nucleotide sequence:

agcaaagcaagaacaccagagaagaagaaaagcactacaga
gaaaaatgtgagcttaagcgctctccaacaacacttctctgggagtc
taaaggatgctgcaaaaagccttggtggtgagacttccgcatatttc
caagcatgggtttatTTTTgttagcacacaaactatctgaccctcga
cttggattttctctcgagtttgtccaactacattgaaacggatatg
caggcaacatgggatcatgaggtggccatctcgtaagattaacaaag
tgaacaggtcactaaggaaaatacagacgggtactggactcgggtccaa
gggtgtagaaggaggactaaagttcgactcagcaactggcgaattcat
tgcagttagaccttttattcaagaaattgatacccaaaagggctctgt
cgtctcttgataatgatgcacatgcaagaagaagt caggaggatatg
cctgacgatacttcattcaagctccaggaagctaaatctgtcgacaa
tgccattaagttagaggaggatacaacctgaatcaagcaagaccag
gtaagaacttctctatccataaaccatagatggagcgattagaatct

taatccatTTTTcagtttttgcaggatcattcatggagggttaatgcta
gtggtcagccatgggcttggatggccaaagagtcctggcttgaatggc
agtgaaggaataaagagcgcttgcaacttaagctctgtggaaatttc
agatggaatggatccaacaatccgatgcagtggcagttattgttgaac
ctaaccaatccatgtcatgcagcatatcagattcatcaaattggctca
ggcgcagttctgcgtggaagctcatctacttccatggaagattggaa
ccaaatgagaaccacacacagtaatagcagcgagagtggtcaacaa
cgctgatcgtaaaggccagttatagagaagacactgtacgtttcaag
ttcgagccatcagttgggtgtcctcagctctacaaagaagttggaaa
acgttttaactgcaggacgggtcgtttcagctgaagtacttggatg
atgaagaagaatgggtgatgctggttacagattctgatctccaagaa
tgtttggagatattacatggtatgggaaaacactcgggtgaagtttct
cgttcgtgatttgtctgccccctctaggtagttctggtggcagtaatg
gttatcttggaaacagggttatgacgtcgtaagacatagacacacaca
gttatgtattcccagtgaaagaatgttggtttatttctctagatatta
gtatgcttataaataggcatgaaggagaaagacaattttgggtatagt
ggagttcagcagaaaatgtatatgtttttcgttttatatgaatcag
agaataaaaagttggatgttatatctacgttgctaattgttgtaacctgc
tcacccatctttcatataagaaaagagaacacttttagttatccctg
tgatgcagaatcgatttctttgttatctctccattcctgtggaaacc
aaciaagtcaactaaatttcggtttaattgggttggtttttaagtcaa
cgaggacttgatttttagttgggcttgggcctataattgtgttcatca
ttgggtttttcccccttatcagtttaacgtccatatccatatcttt
ttcttttttaacggcaaagttcatatccatatcttatgatgtgcct
aaaagaggggagaagatgcgaagacagaattttcatatttgaaaggggt
tcgatatcgatattgggaaacgaatcaagggtcaaaaaactcagttca
atagttgaaatttaaaaattttattaattcaatccgattgggttcgt
tttggttatgggttcggttctatatcatcaaaccaatcggtttgggtcct
aaagataattataaatattcaccaacaccagtgtaaacaacatatca
acaaacctaaagttagataaacaagaga.

146. An isolated promoter comprising the following nucleotide sequence:

aattggcactcttcttctgctgggttccaaaagaaacgaat
caatatgtgcaacaagaagagctccagaagcagtcattcttctaaaat
cttaatctaacaacagctcaagaagaaaaaattccatagctagaga
gaacacaaagtcacaagacgacgtcgtagaggcacaagtcaaacct
gaatggcttaagccgaactgagtgggtttgactagaccatcatcaga
aaagtctccaagacggtagtcggatgtagatcgctcaagtaatttt
tgggttttggtgtctcacgttttcagctgccccatttgatttcagttt
gggcttttcttattctctaaaggcccaatttcatttaggtttagttt
atttgatcattatcttactataaaggcttcgcctttcgagaaattt
aggggttcttctgtctgtctcgtcactcaggtttgtgcctcaacgac
tgettcacttctagcttgattcttcttcttctggttatatgtatactg
tacattagattattcttgggttctcgagcttctgctatagattttgat
tcttttttttgggtgtctttggttctggttccaggatcagatcttagct
aaattgagacaagctcaaaatgaggtacttgacgcatctcttaoatt
cactgtttaattagagaacaatacgtctctgaatcgtgattcagaga
cgtattgttcttctgtcatatgcaataagtttaattagagaacaata
cgtctctgaatcgtgattgttttttggatgtgcgttattgatagctt
tatgatgttaatagtctaggattgacacgaagttgttctgcagtttt
gcataaatgctctttactaaggcctctaaatttggatgacaaatcta
aatcttgcctcataaaaaatttaggtgtattaagataagattattttg
tatggtagtgtctataatgtgggttgttcatgttgaggttgtcaatg
ttgtgtatttttgggttgggttagttaatttgccttaactctgttcttg
tgggttaatacagtaagcttcagagtgaggccgttcgtgaagccatc
actactatcacagggaaatccgaggcaaagaaacgtaactttgtcga
gactattgagctccagatcgggtctgaagaactatgaccctcaaaagg
acaagcgtttcagtggtatctgtcaagttaccacatatcccccgctcct
aaaatgaagatctgcatgctcggagatgccagcatgttgaagaggt
gatatacttttcatggaaattgatcattttgtgctctgtttcttgt
ataatgggttttgtgctcatttccatttgggtggctctattagtttcatt
tgatgttgtatatgtcttctgaatgtagatgcatgatgttttcggaa
tttgggtcattgtttatttaggcttcatttcttgcataattaaatatt
tgcttatttccatcttgtatcttttctgtaggctgagaagatgggggtg
gaaaacatggatgttgagtcctctaaaaaagcttaacaagaacaagaa
actcgtcaagaagcttgcaaagaaataccatgctttcttggcctctg
agtctgtcattaagcagattcctcgtcttcttgggtcctggctcttaac
aaggcaggcaagttctggctacagctaataattccattgttcttctt
acatccgttttgattttggataggttttagtagtctatttcttttgt
caatgtctttttgatacaatgccaatcctttatcctgtgagattatg
cttctttgatgattcttaagtaacattcctttgctttactttacaca
ggaaaattcccaactcttgtgagccaccaggaatccttggagtcaaa
ggatgaatgaaacaaaggcaacagtgaagttccagctgaagaagggtc
tgtgcatgggagttgcagttggtaaccttt.

147. An isolated promoter comprising the following nucleotide sequence:

```
ttggcaaactgagatataagaggggaaggtgattttcatgcaa
atTTTTTTTTTattTTTTTTTgaatgaatgcaaaatttattcaaaaa
aaaaaacctgggctacatcaagtacttcatttctgagtttttgaaa
aatctaaagacaacaaaagactttacaatttaataaaaaaataataa
aaatactttatcactctcaacgaaattgttgatttaataacgtatct
cttggtaaaacagcgttttatttgacgaaattgttataaatgaataa
aatgataatagaaactagtgtggtacgtaaaatacctctcatttggc
aaaataacgggttatgtatcatgagatttgcatacgcacagcggtgctta
aatagtgtgctttcaggagaaaatatataccaagttatttgctgaaa
ttaccacgcaaatctgaggttcgaatggcaaaataaaaaaccaatgt
catttccttaattgtatttaagggtcatttaataaaaattgtacactttt
ttcacctgttaagcgttccaaagtgtagaatggataactagaagggctc
aaagggtataatattaataagcgaactcactttttgcccaagtgattt
cacttcttacatttgcttgatagttacccaaaagtgtatatatat
tcctttatacaattgttctattttctggattataaggggaataagaa
aaaagaaaagagagagtataataataacttttataaagtgatgtta
gattctaatttgtaacgaaaagttcaaagtgaagaaaaaacgaaaa
agtttttctgttttggttttatctatagccaagaaagtttctcaga
tttacaagaagttaactgagaaaaacaaaaaaaaaacttatgaagca
tgaaagactaattaacgaggtgatttaattttgagacaaattaaacat
cgaattaaaagtaacatttgagggtttatatgttatatatgtgaca
tgataagtccgattcatgactaatgtatatctggaatctaacatgga
agaatagagaacgaagcagagccaaggtcaacttgccagacacgaat
caacagattgtgaatgagaccaaatcaatggtcataaacgggtggg
tttaaacgggcaagtcaccttggtcaattccattcgttattcctt
catgcaagaccctctgatacaaccaaagactcccattacaatatctt
ttcgtacacgagctacttattttcaaattgtgttacctcttctcgtgac
tcttggtgtgtgtggtaaagcctagtcgagatgtgtcggtatatata
ggcatacatatacaaatgcgacaaaataagtatatttatattgtttaa
tttctatattccatttctatatgcatggctgggatttttgaccaaaa
ccctaattcaagaatagaatccaaaagatgggatcaaagaatataat
ctaattgggctgaccacattttccgattttaattcgcatagttaatat
ctttccactactttatgccgcagaaatttgtaattaaagtaagacaaa
gaaatacagatataagatgggtcgtagaaaccagtagaggaatttcat
ttttcgtggataagtggaatattaataagagaatgggtctttactctt
tacagtgggaaatgggaatagtagccattataatttcatcagattc
tatatatgcatgtttgtataagctaaaataaaatacgtttaagcatte
ttcaaaaaaatttacaagttctagagactctcttaacgtcggcaatt
tatattctactttacatgacactttcaggaaaagaaaactatactca
ctagcagatcattaaattttctttttcttttttgaatgaaccttag
ttgtgggtttttattttttgttagctagaaacttcagtggtttttttcc
gccaatggtagtgctttgatgatgggtccgg.
```

148. An isolated promoter comprising the following nucleotide sequence:

```
caatcaaggtaacgaaggaggatcagcgaaaggatgggcta
tat t t t g g a g t t t t t c c t g c g t g t a a g t a a t g c t t t g t g a t c t t c c a
t g c g g a c a t a t a a c t g a a g a a t a a a c t c a a c t c a t t g t g t t c t g g t g
t g t t t c t t c t g a t c a g a t t c c t c g t t g c a t c t g c a c t t t t c t g c t g t
g g g g g c t t t a t t t a t a a a c a a g a g t a g a g c g t g t g g t a a t c t t c a t
a t c t t t c t a c a a t t c c a c t t c c a t t c t c t a a t t a t t c t c t c a c g t g a
t a t a c a c a c a c t c a a t c a c t g a t g t a c t c g t a t g g a t g c a g c g t g g a
a c t g a t g c a t t g c c g g g g a t g t c a c t t c t a t c g g g c t t a c t a g a a a c
t g t a a g t a t t a c a g a a a a c t c a a a a g g a t t c c a t t t a t g c a a a a t c
t a a g a g a a a g c t c a c t g t g g t c t t t g g t t a c a a t t t a t g g a t c t c t c
a a g a g a c a a a t g c t a t g t a a g c t a a t t g a t t t t g g t c t t g a t a a a c a
g g t g a g t g g a a g t g g a c a a a g c t a c t c a a g a a c t g a a g a c a t c a a c a
a t g c t t t t g c c a a t g a a g t c t c a t g g g a c c g c t c t t c c g c a t c t t c t
a c t c a a g c g a c a a c a c a c a g a g a c c a a g t g a a g a a c a t a t g g t g c
g a t c t a a t t t t g t c a a g t g c c t c a c a a g a g g t a c t g t t t c a a g c c a t
g g t a t g g c a c g c t t g t g a t c t g c g a t t t c t g g a t t t t g c t t t g t a t g
t t t a t t t t c t a c c t t c t a g a a a g a g g t c a a a a a g t t a a t a g c t t c a c
c g t g a g a a t g t t g t t t t c a c c a g a t t c a t g t g c t a t g a t a g a a a a a g
a c a a a g c a a a c a a g a g t t c t t t c t t t g c t t a g g t t a c a a g a c a a g a
g t a t c g t t a t a a a g t c a a c a a a g a t t g a a c a t a t t t t t g t c a a g g g
a g t g g t t a g a a t c t c t t c c t a c t c t c t t g c c t t t c t c a c t a a g a c a a
a a a a a a g a c t t g g a c t t t g t c t a a g g t t t t g t g g a t a t t a t t a a c c a
a g t c c t t t t g c a a a a a g t a a t a t t g t t t t t c g c a t t c c t c t t t t a g
a a t t t a g t t t a a t c t a g g c t t t a t a t t g g t t a t t a c t t t c t t g a a a a
a t g a t c t g t t t a t t c t a t t c a t a c t t g g t t a c c t c g c t t t t t a t c t t
a c t t c t a c a a a a g g a t t a t c a g t g a a a g t t a g t c t c t t a c t c t c a c c
t t c c g a a a a t a a a c a a a a a t a t c g a t a c t t c t a g a t c a a a c c a a g t
t g a t t a a a a c a t c c c t a t t c c c t a c g a t t c t g a t c t t g a g a t a t a t t
a t c a t g t t a a g a t c t a a a t t g a c a a g a a a a c t g a t t t t t c a t t t c t a
g t a g g a a a a a t a a t t a c t a t t a g t g a t c a t g a t t g t c g a c c g t a a g a
g g t g g t t t a g t t a c t c t c c a t c t t t c t t t g a a g a a g t c a g a a a g t c a
g a a a t t a t a t c a a a t t a a c a t c a a t a t t g a a c a c a t a t a t c t g t a t
g g t t t t a t g t t t a g a a a a t t c c a a t a t t t a t a t a t t c c t a g g g a a a a
a g a a g c t t a t t c t t c a a a t t a t t g t t a t g a g t c g t t a a a a t a t g g a t
a a a a t a t a a a g t c t a a a t a t t a a a a a c t c a g t t t g c t t t g c t t t t a
c c t c t c c a a g t c t c c a a a g t c a a a t t a a t t t t a g t t a a t t a a a c c a a
a a a a g g t t t a t t a g t c a a a c t t a g c a t g c a a t g c t g g g t a c c a a a c c
c a a g c a t t a g t c t c t t t t a a t c t t c t t t t c t c c a a t a a g t t t t t a c
a a t t t t t a a t t g t t t g c a t t t c c c t t g a t t a t t t a t c t t c a t c c c a a
t t t a g c t a a t a c c a a c t c c g t t t c t t a t t c t t c c a a g t c t t t t c c t a
t a a a t a c g t t c t t c t t c c c c t c t t a t t t c a t a t c a c t c a c c a c a a a g
t c t t c t c a t t t c c t c a t .
```

149. An isolated promoter comprising the following nucleotide sequence:

atgttgtagtgagtgaaggagaagaagagggaaacaaaggtatt
tatttgtagcgaggtttgttttgtagcggtttgtctgtgttcaa
tggtgacgaaacgagtgagagagtgtctgattattaaagaaaaccct
aattaagtcagacccgccggttataaaaatagtcaaaaagtaggaaa
acgcgtgtgtgagtgagacagagacagccattgtttgctttatggg
cttataagcgagacgtgttaattgggctttttcctttatggccgaaa
acaaaagaaacgtcgctgagagattcgaactctcgcgggcagagcc
catgtacttagcaggcacacgccttaaccactcggccaaagcgactt
gttgctatgagttagacaaaatcattaaaattctctattatgatttc
tcatagtgtgtgtgtatattgtggatctactaaaaattctttgttat
tattactttattttgtgaattagtttgatataggttaagtacaaagt
aactttattatttactcaaaatttatcagattaactgattttatatt
gtttcctttggtatatagacgtactatagtttttagaaaaaccataa
gattccttttatatttcatagagtgaagagatgagatgagatcttggc
tgagagaagaaataagtttccacgaggaggactcttttttttggtga
agacgaggaggaggactcttggttgatccagtctttacgttagacat
cgaccctacattttatttgctttctctatcaacatggcaggtaaaa
atcttcattcaaccgaaccaaccaagtctcttcccaataatattca
agcaccatcctttgggaaactcatacatactacagtctacactcttt
cattttctttcaacgctcaacttaacaaatgatatagtttagttgtc
aattatatgttttaattagtgttttcacatcaaattctggtttgata
tttgatgactattttcggaacatctcaatgtcccgcaaatacaatc
gtctatcatatataatcccgtacgttgattcttatagatagaataa
tatggcgtgatctttataatataacatatagaatcgtgtagatttat
tttattttatttttatatcgcataaattgcaaaatacttatatat
gtttgttatatatgataccatttttatagttacttaaaaaaggttaa
gcgataatatatatatacaactttttataacaaaaaagtataaacac
atggtaaagaaaaataaaaaatgaagacatggtgtgacacgaaaatgg
cactaaatatacatatataatagatagctacaatatcccatcataca
cacttttttaattgactaatacataacttacacacttttttaattga
ctaattcataactttttatcattgtcaacatgcaaatcatatttcc
gttgaactattattcttattttgtttttaaaagaagggttccctgg
aataaaaaatagatttccaaatgacgttagagcaaaaaaaaaaag
gttgctctggctggtaaaatgaaaaagcaaagcgtcttggatatagaa
aagtaatatactgcctcctaattttcttcgtccttctaccgaagaatc
tctccactcttgcctcttttcgaaaccctaaccagaagcaccagat
tttttcaactttttcccagagaacaatagaaaacccaacttgtgctc
tctagggtttttctttattccttctcatctttggattttcttgggtca
tcattttggaagcttaccaccagcgaaaaaattataacttccatcg
attcctgggtctctctctctcgtctctctgcatgtgctaaatcgccg
gactgatcctcactgtcacctctgtt .

150. An isolated promoter comprising the following nucleotide sequence:

gatttaggggtttgagttgtcactggaaagaggtttgattgt
gagtgatgatggagagattatgaaggagtttgtgtgtatttatagag
gagttaggggttttgagggttgatgagaagtaggtttgaagaagttt
gttgttgcaacttatttagagttacttgttccacaaccacaagtaag
attggtcacttctaagttctaactagaaacaacctgacacatggag
atctcagctaacctagttaaagtatatgtatttatattttatttaa
tattataaaaataaaaataaattttcacaaataaaaagaactacaaaaa
gtgagaaaaataatgtgataaacaatttagaaaattagtatatcaa
taataaaatttataatccgatgggttttgccttttgggtttggcctttg
tttgaacttcgatgagtgactatgtatagcgaaaacaattcgggttg
tttttgggttaattttaaaaaatacaagcgacaatatctgatgagaa
taggtgaaaagcaaataatatcagtttaattggaaatatctactttt
ttacaactaatattttgtttgggtcaaccaacaaatagatttaattaa
ttatgggtttatgagcttttattttgttgcgacagtatatatatgttaa
aatagtgatattgcatggcggaaggtccggaagcaacacatatctcc
tttttaatttttttttaacaagaataacatgttaatttttttttga
aattaataaagaatacatatttctaatttttgcgtcagatagatgat
taaagagtgtgtgttttttttaacaaacaaggaatacattatacata
tttcatatttctctcgacattgtttgttttttaaaaaatagattaa
agagtctacgaagctaagtagctaacgaagacttgaaatgagaagaa
gacgagaatcttttaataattttttgttaagcgataatattttgaaaa
ttaataaatatagattaagggaataacaataacgcagatatcggtaa
gtcatagaaaaaaagaaacaacacaaaacttacataaacatgtttcct
aatttgtaatggagtaaaattccttcttttttttttttttttgattt
ggattccaattagtaaaagaactcaatgactataaaataacctttaacc
ctctcattatttcttactatcaattgattaagctctcgttcctaaga
aagcaatagacgaacaagaacccatcgaagaacacaaatctctcttt
gaagttgtcgataatgttagtacaccgttacttcgtccaagactttt
ttgcggttcggtttcttacaacaaggatttggttaccattacttt
tgtcgtaactcctttttacatgtacgtcaaaaagtggttcctcgctc
cggcttgaagaaacgaccttcttaccacaaaaagcttattttaaac
cgtctaaaaccggaaaatctcaatctaaaccggatacgggttcattgag
aaaccgattcaaaccggagtgaagaagtagaattttttgatgggtc
cgtcacaatgtgtgctgctccttcgccaagacatgtaccgattccga
tattttgtgggtgtaagatgatcaaagagtcctcaaagctaagcacg
acttgaatgagaagaagaagaccaattactcaattagattttgtttt
gtggagcaattattgtctatttatctttgttttttagcaaataatctg
tatccactaatcttcacagtacttgactaacaagaagtaaagagttt
tcttattttccaattgttttttaatctgatacttttttcataatttta
caatgtttgatgaaaaaaaacattcaaaccctaaattttcttttttg
gtatgaattcaaacctgaattacttttgacgaggacccgacgggtata
aatagggtgatctcccaacaacaaaaagggt.

151. A transgenic plant or transgenic plant tissue comprising an isolated promoter according to any of claims 143 through 150.

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APPENDIX 1

SEQ ID NO:	INTERNAL IDENTIFIER	FUNCTION OF POLYNUCLEOTID E / GENE
1, 2, 3	2293133	glyceraldehyde-3-phosphate-dehydrogenase
4, 5, 6, 7	7143495	Histone H4
8 & 9	7143515	ATP dependent RNA helicase, mRNA sequence
10, 11, 12, 13	7143527	nematode specific
14 & 15	7143602	protein serine-threonine phosphatase 1, catalytic subunit
16 & 17	7143612	40S ribosomal protein S4
18	7143666	cytochrome p450
19, 20, 21, 22	7143675	Neuroendocrine protein 7B2
23, 24, 25	7143839	nematode specific
26	7143863	40S ribosomal protein S17
27 & 28	7144016	vacuolar ATP synthase subunit G
29	7144025	malate dehydrogenase
30 & 31	7144060	J2 pcDNAII Globodera rostochiensis cDNA similar to Bystin, mRNA sequence
32 & 33	7144225	similar to arginine kinase
34	7144354	pyrroline-5-carboxylate reductase

SEQ ID NO:	APPENDIX 1 (cont.) INTERNAL IDENTIFIER	FUNCTION OF POLYNUCLEOTIDE / GENE
35, 36, 37, 38	C10	ribosomal protein L18a
39, 40, 41, 42, 43	C118	ribosomal protein S11
44 & 45	C122	ribosomal protein L16/L10E
46 & 47	C127	FMRFamide-related neuropeptide precursor
48	C129	ADP-ribosylation factor 1
49	C130	ribosomal protein L11
50	C137	nematode specific; conserved in <i>C.elegans</i>
51 & 52	C138	ribosomal protein L7
53	C145	ADP/ATP translocase
54 & 55	C148	troponin
56 & 57	C154	calponin
58	C16	translation elongation factor EF1A
59 & 60	C18	40S ribosomal protein S16
61	C27	ubiquitin
62 & 63	C46	nematode specific
64, 65, 66	C48	ribosomal protein S3AE
67	C59	40S ribosomal protein S5/S7

SEQ ID NO:	<u>APPENDIX 1 (cont.)</u> INTERNAL IDENTIFIER	FUNCTION OF POLYNUCLEOTIDE / GENE
68	C8	glyceraldehyde 3-phosphate dehydrogenase
69 & 70	C82	60S ribosomal protein L30/L7E
71	C90	glyceraldehyde 3-phosphate dehydrogenase
72	C135	nematode specific
73 & 74	C206	predicted troponin
75	C227	cytochrome P450
76	C238	vacuolar ATP synthase subunit G
77	C246	40S ribosomal protein S4
78	C308	FMRFamide-like neuropeptide precursor
79	C342	ubiquitin
80 & 81	C344	nematode specific; conserved in <i>C.elegans</i>
82, 83, 84, 85	C370	40S ribosomal protein S5/S7
86	C426	nematode specific
87	C458	histone H4
88 & 89	C481	ribosomal protein L30E
90 & 91	C556	nematode specific; conserved in <i>C.elegans</i>

SEQ ID NO:	APPENDIX 1 (cont.) INTERNAL IDENTIFIER	FUNCTION OF POLYNUCLEOTID E / GENE
92	C628	ribosomal protein S17E
93 & 94	C665	malate dehydrogenase
95 & 96	C669	malate dehydrogenase
97	C694	ribosomal protein S3AE
98 & 99	C709	ADP/ATP translocase
100 & 101	C714	ADP-ribosylation factor 1
102	C721	calponin
103 & 104	C726	ribosomal protein L11
105	C736	nematode specific
106 & 107	C773	troponin
108	C834	nematode specific
109	C860	bystin
110 & 111	C863	troponin
112 & 113	C883	translation elongation factor eEF-1A
116	C888	40S ribosomal protein S16
117	C898	glyceraldehyde 3-phosphate dehydrogenase
118 & 119	C935	peptidyl-glycine alpha-amidating monooxygenase
120 & 121	C937	calponin
122 & 123	C942	peptidyl-glycine alpha-amidating monooxygenase

SEQ ID NO:	<u>APPENDIX 1 (cont.)</u> INTERNAL IDENTIFIER	FUNCTION OF POLYNUCLEOTID E / GENE
124	C954	arginine kinase
125, 126, 127	C969	calponin
128 & 129	7235653	ribosomal protein L18A
130	8005381	neuroendocrine protein
131	7235496	pyrroline-5-carboxyla te reductase
132 & 133	7275710	protein phosphatase pp1-beta catalytic subunit
134	7923685	nematode specific
135	7641370	40S ribosomal protein S11
136 & 137	7923404	nematode specific
138	7797811	ATP-dependent RNA helicase
139	7143613	predicted phospholipase D

Appendix 2:

Exemplary genes used for RNAi vectors.

Promoters:

Constitutive:

Super Ubiquitin from Pine

CCCGGGAAACCCCT CACAATACATA AAAAAAATTCCTT TATTTAATTATC AAACCTCTCCACT ACCTT
 TCCCAACCAACCGTTA CAATCCTGAATG TTGGAAAAAAT AACTACATTGAT ATAAAAAACTA CATT
 CTTCTTAATCATAT CAAAATTGTATA AATATATCCACT CAAAGGAGTCTA GAAGATCCACTT GGACA
 AATTGCCCATAGTTG GAAAGATGTTCA CCAAGTCAACAA GATTTATCAATG GAAAAATCCATC TACCA
 AACTTACTTTCAAGA AAATCCAAGGAT TATAGAGTAAAA AATCTATGTATT ATTAAGTCAAAA AGAAA
 ACCAAAGTGAACAAA TATTGATGTACA AGTTTGAGAGGA TAAGACATTGGA ATCGTCTAACCA GGAGG
 CGGAGGAATTCCTA GACAGTTAAAAG TGGCCGGAATCC CGGTAAAAAAGA TTAATTTTTTTT TGTAG
 AGGGAGTGCTTGAAT CATGTTTTTTAT GATGGAAATAGA TTCAGCACCATC AAAACATTTCAG GACAC
 CTAAAATTTTGAAGT TTAACAAAAATA ACITGGATCTAC AAAAATCCGTAT CGGATTTTCTCT AAATA
 TAACTAGAATTTTCA TAACTTTCAAAG CAATCCTCCCC TAACCGTAAAAC TTTTCTACTTC ACCGT
 TAATTACATTCTTA AGAGTAGATAAA GAAATAAAGTAA ATAAAAGTATTC ACAACCAACAA TTTAT
 TTCTTTTATTACTT AAAAAACAAAA AGTTTATTATT TTAATTAAATGG CATAATGACATA TCGGA
 GATCCCTCGAACGAG AATCTTTTATCT CCCTGGTTTTGT ATTAAAAAGTAA TTTATTGTGGGG TCCAC
 GCGGAGTTGGAATCC TACAGACGCGCT TTACATACGTCT CGAGAAGCGTGA CGGATGTGCGAC CGGAT
 GACCCTGTATAACCC ACCGACACAGCC AGCGCACAGTAT ACACGTGTCATT TCTCTATTGGAA AATGT
 CGTTGTTATCCCGC TGGTACGCAACC ACCGATGGTGAC AGGTGCTCTGTT GTCGTGTGCGCT AGCGG
 GAGAAGGGTCTATC CAACGCTATTAA ATACTCGCCCTC ACCGCGTTACTT CTCATCTTTTCT CTGTC
 GTTGATAATCAGTG CGATATTCTCAG AGAGCTTTTCAT TCAACCCGGG

Strawberry Banding Vein Virus 1

aagctttttcactgtgggttaatttcattaatctatccaggtgaaaacctcaaggaga
 tctctcttctcccaaaagacctctacagggcaatcaaaaactacagaaccagagttt
 gtagtgacagagtagaccaatctacctgagaatcacgagtaccttcctagagtggtg
 aaaatgatgacatccttattccataccactggattgaggtaggactatccaatggaa
 aaattccatgggacaagtcatataagaagaccgcaacagtcgagtatcttccagaga
 taactgcactcagacctaaaaggataaaaagcagtatataatcagtgactaagatct
 tcgcagattcaaagaagaagctt

Strawberry Banding Vein Virus 2

Gtttaaacacagcccaagataacagaaaagtc aaagggtgttcgaaagaccacttgt
 gactaaggatcatttcataaattatctggtagcacagactcatgataactgcga
 ggaacacaaagttctttacagtcgattcaaagacactttctctttacggtttcattga
 aggagccgacccagaatatgtcagagaagcttttctactgtgggttaatttcattaat
 ctatccaggtgaaaacctcaaggagatctctctctcccaaaagacctctacagggc
 aatcaaaaactacagaaccagagttttagtgacacagagtagaccaatctacctgag
 aatcacgagtaccttcctagagtggtgaaaatgatgacatccttattccataccactg
 gattgaggtaggactatccaatggaaaaattccatgggacaagtcatataagaagac
 cgcaacagtcgagtatcttccagagataactgcactcagacctaaaaggataaaagc
 agtatataatcagtgactaagatcttccgagattcaaagaagaagcttaactatgc
 tgatgacaagataattctaataagcaattattcagaattaatcaaggagaaagaatt
 aataactctttcagaatatgaagcccgctttacaagtggtccagctagctatcactga
 aaagacagcaagacaatggtgtctcgatgcaccagaaccacatctttgcagcagatg
 tgaagcagccagagtggtccacaagacgcactcagaaaaggcatcttctaccgacac
 agaaaaagacaaccacagctcatcatccaacatgtagactgtcggtatgcgtcggct
 gaagataagactgacccagggcagcactaaagaagaaataatgcaagtggtcctag
 ctccatcttagctttaataattatgtttcattattattctctgcttttgctctctat
 ataaagagcttgtattttcatttgaaggcagaggcgaacacacacagaaacctccc
 tgcttacaaccatgtattgtagctaaacctcttaggaggatattc

Nematode Inducible:**Trypsin Inhibitor from Arabidopsis (clone#6598343)**

ccccgggagcaaagcaagaacaccagagaagaagaaaagcactacagagaaaaatgtg
agcttaagcgctctccaacaacacttctctgggagcttaagagatgctgcaaaaagc
cttggtggtagacttccgcataattccaagcatgggtttattttggtagcacaca
aactatctgacctcgacttggattttctctgcagtttgtccaactacattgaaac
ggatatgcaggcaacatgggatcatgaggtggccatctcgtaagattaacaaagtga
acaggtcactaaggaaaatacagacggtagtggactcggccaaggtgtagaaggag
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aattgataccaaaaggggtctgtcgtctcttgataatgatgcacatgcaagaagaa
gtcaggaggatatgctgacgatacttcattcaagctccaggaagctaaatctgtcg
acaatgccatttaagttagaggagatatacaaccatgaatcaagcaagaccaggaaga
acttctctatccataaaccatagatggagcgattagaatcttaatccattttcagtt
tttgaggatcattcatggagggttaatgctagtgggtcagccatgggcttggatggcc
aaagagctctggcttgaatggcagtggaagataaagagcgtttgcaacttaagctct
gtggaaatttcagatggaatggatccaacaatccgatgcagtggcagttattgttgaa
cctaaccaatccatgtcatgcagcatatcagattcatcaaatggctcaggcgcagtt
ctgcgtggaagctcatctacttccatggaagattggaaccaaatagagaaccacaac
agtaatagcagcgagagtggtatcaacaacgctgatcgtaaaggccagttatagagaa
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caaagagacccggg

**Arabidopsis Transmembrane Protein from Arabidopsis
(clone#6468048)**

ccccgggaattggcactcttcttctgctgggttccaaaagaaacgaatcaatatgtgc
aacaagaagagctccagaagcagtcattctctaaaatcttaatctaacaacagctca
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ggcaciaaagtcacaacctgaatggcttaagccgaactgagtggttttgactagaccat
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**Diaminopimelate Decarboxylase from Arabidopsis
(clone#4159709)**

ccccgggtggcaaaactgagatataagaggggaaggtgattttcatgcaaatttttttt
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tgctttgatgatgggtccggcccg

Peroxidase from Arabidopsis (clone#4006885)

ccccgggcaatcaaggtaacgaaggaggatcagcgaaaggatgggctatatatttgaggat
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aaatacgttcttctccctcttatttcatatcactcaccacaaagtcttctcattt
cctcatcccg

**Mitochondrial Uncoupler from Arabidopsis
(clone#4220510)**

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gagttttgttttgtagcggttttctgtgttcaatgttgacgaaacgagtgaga
gagtgctgattattaaagaaaaccctaattaaagtcagaccgcggttataaaaat
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63

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cttccatcgattcctggcttctctctctcgctctctctgcatgtgctaaatcgccgg
actgatcctcactgtcacctctgttcccggt

Stress protein from Arabidopsis (clone#6598614)

ccccgggattaggggtttgagttgtcactggaaagaggtttgattgtgagtgatgat
ggagagattatgaaggagtttgtgtgtatttatagaggagtttaggggttttgaggttt
gatgagaagttaggtttgaagaagttttgtgttgcaacttatttagagttacttggt
ccacaaccacaagtaagattggtcacttctaagttctaactagaaacaacctgaca
catggagattttcagctaacctagtttaattgtatatgtatttatattttatttaaatat
tataaaataaaataaattttcacaaataaaagaactacaaaaaagtgagaaaaataa
tttgataaaacaaatttagaaaatttagtatatcaataaataaatttataatccgatgg
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tatgaattcaaaccctgaattacttttgacgaggacccgacgggtataaatagggtgat
ctcccaacaaacaaaaaggggtcccggt

Pectinacetyl esterase from Arabidopsis

(clone#6671954)

ccccgggtggtggggacaatggatccggtctgcgtagcaacaaggctgaaaaagatta

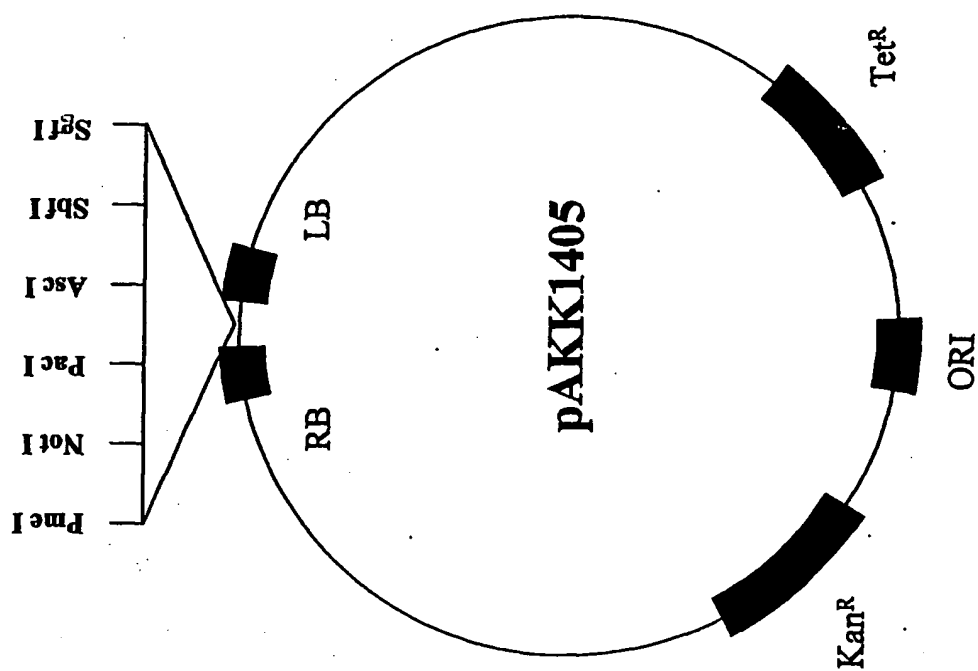


FIG. 1

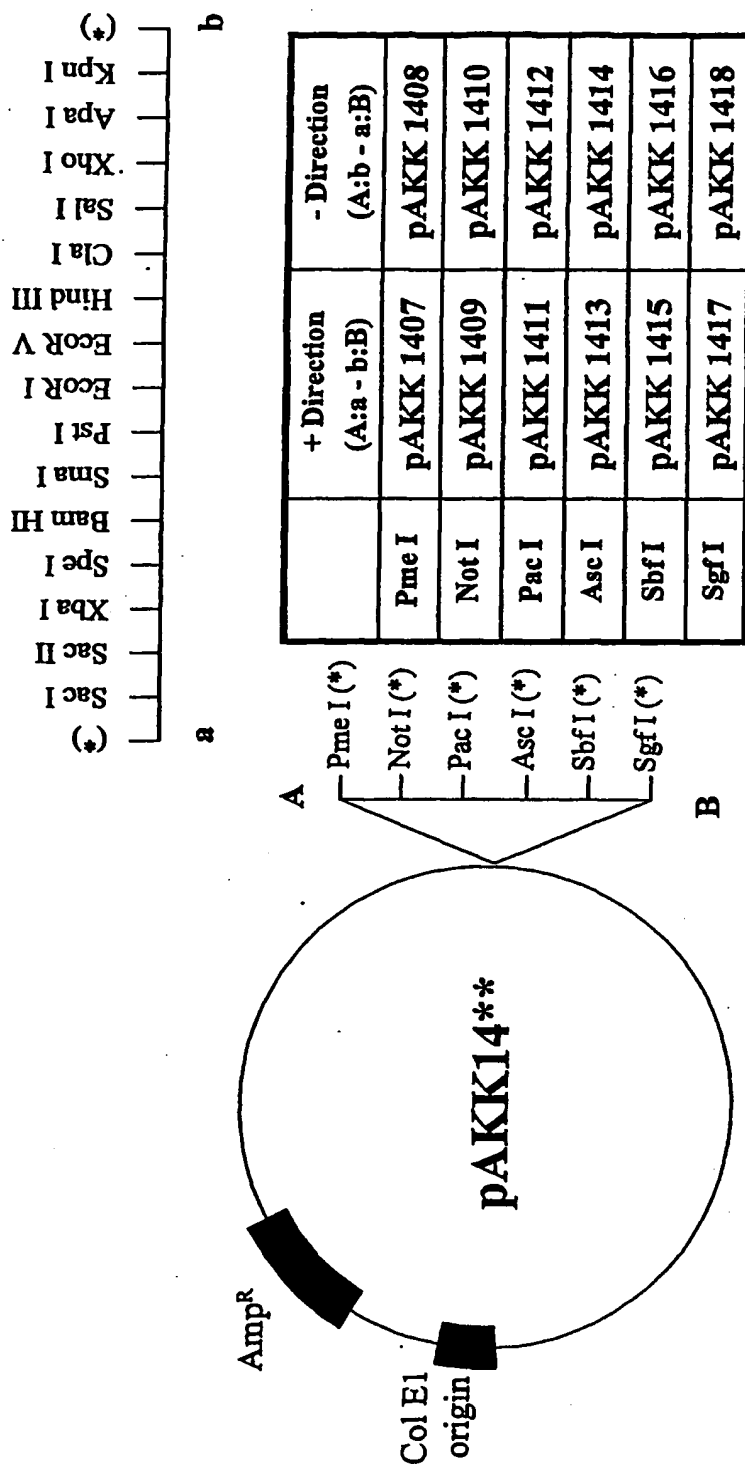


FIG. 2

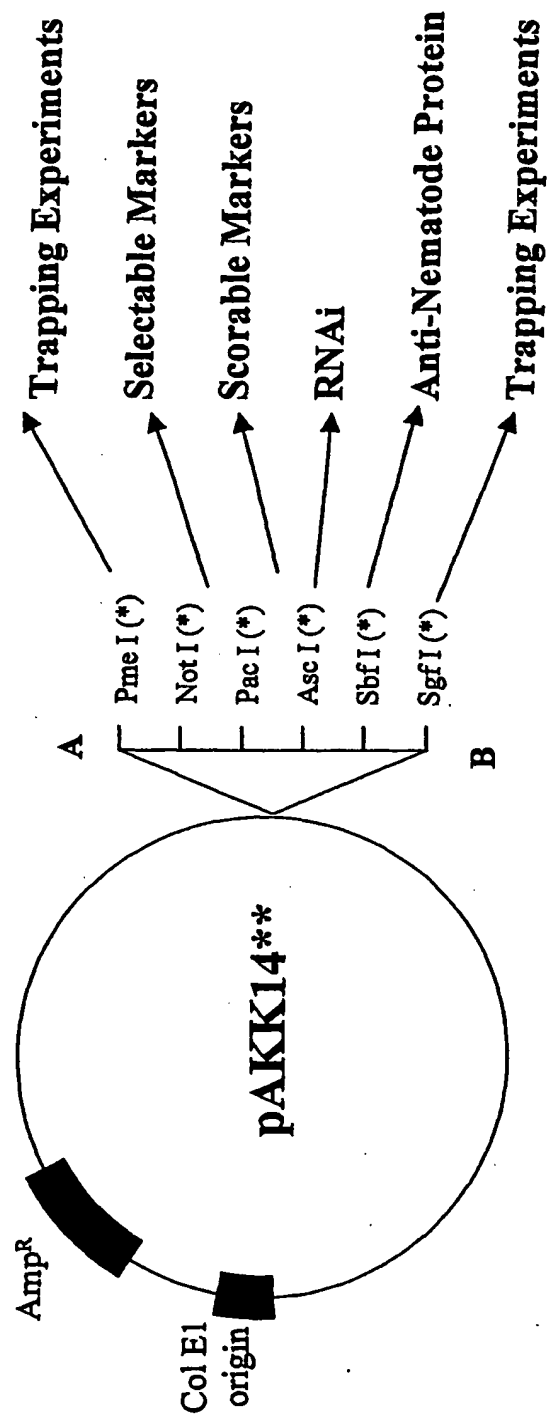


FIG. 3

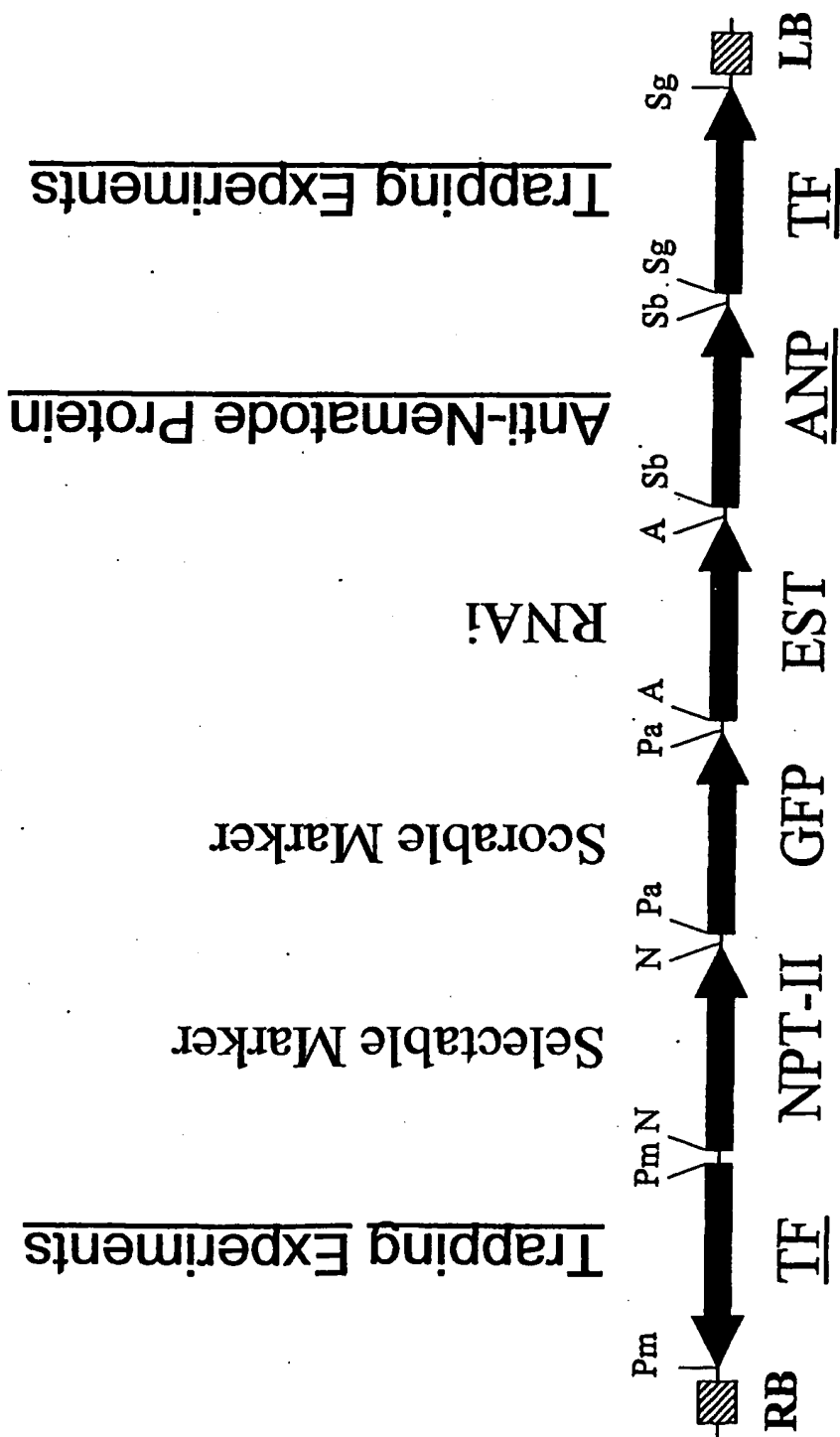


FIG. 4

Selectable Markers

pNOS / NPT-II / tNOS

pSU / Bar / tNOS

pSU/ Intron / Bar / tNOS

pUBQ3 / Intron / PMI / tNOS

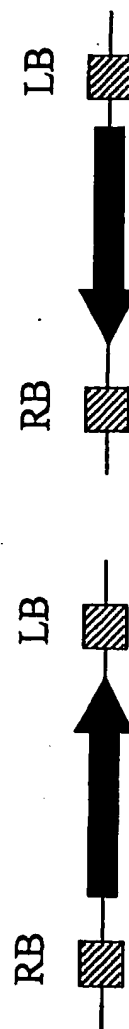
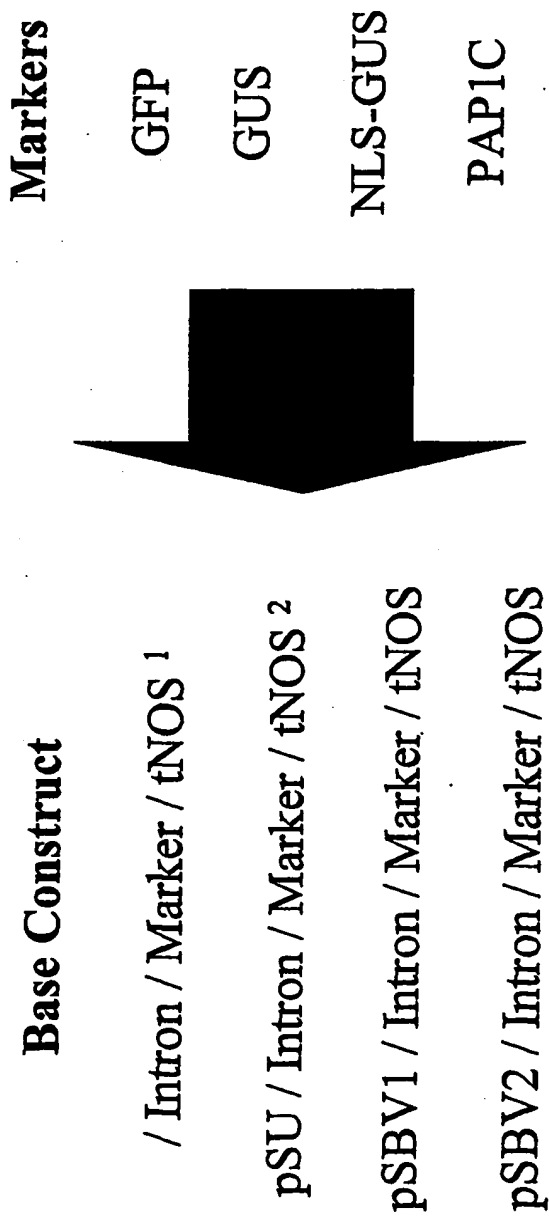


FIG. 5

Scorable Markers



¹ Construct useful for promoter analysis.

² Construct useful for high constitutive expression of genes of interest.

FIG. 6

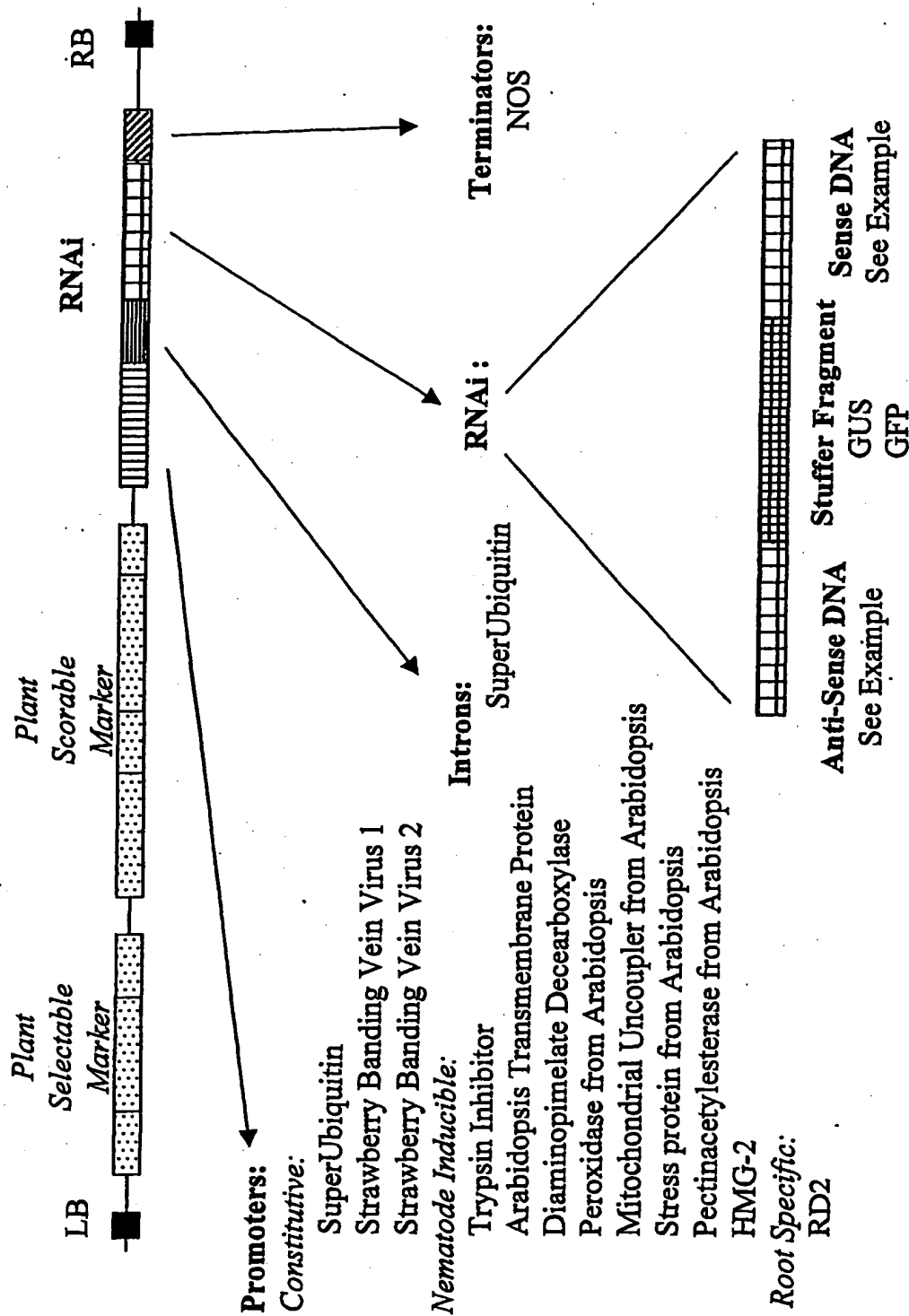


FIG. 7

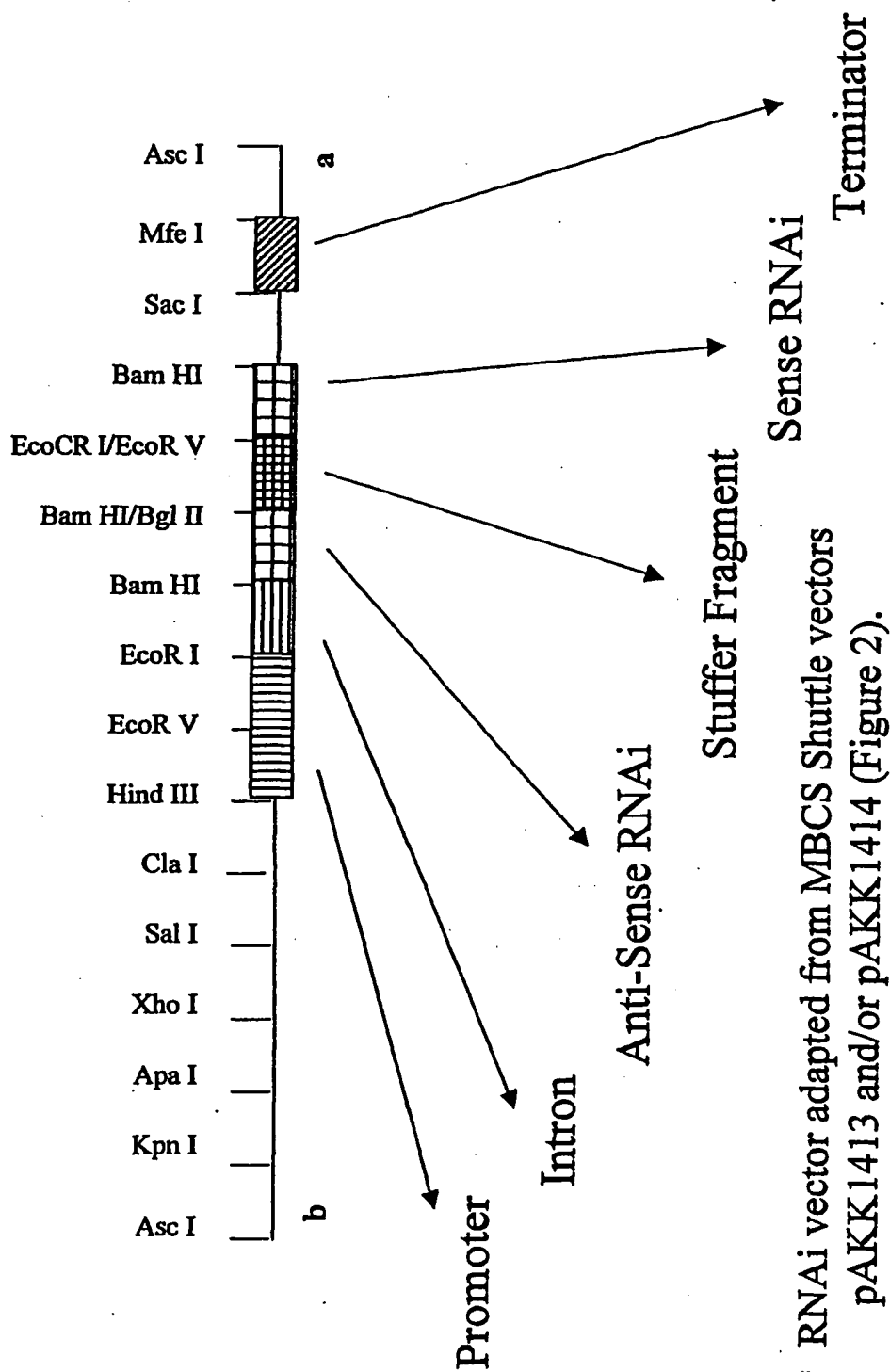


FIG. 8

AKK110P1
SEQUENCE LISTING

<110> Mushegian, Arcady R.
Taylor, Christopher G.
Feitelson, Gerald S.
Eroshkin, Alexey M.

<120> Materials and Methods for RNAi Control of Nematodes

<130> AKK-110P

<140>

<141>

<160> 139

<170> PatentIn Ver. 2.1

<210> 1

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<213> Globodera rostochiensis

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gcttggcggtt gcgcgctgcg gttgagaagg acaccgttca ggtgg 165
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<210> 2

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<212> DNA

<213> Globodera rostochiensis

<400> 2

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<210> 3

<211> 205

<212> DNA

<213> Globodera rostochiensis

<400> 3

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ggtcagctgg tacgacaatg aattt 205
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<210> 4

<211> 167

<212> DNA

<213> Globodera rostochiensis

<400> 4

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tcgtccattt gtcaattgtg gccctaaaga gggccggttg ggtagtttt ttggtgttcc 120
ttctccttgc tggctcaacc accgaagccg tacagcgctc ggccttg 167
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<210> 5

AKK110P1

<211> 41
 <212> DNA
 <213> Globodera rostochiensis

<400> 5
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<210> 6
 <211> 79
 <212> DNA
 <213> Globodera rostochiensis

<400> 6
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 cttaacgcct ccacgacgg 79

<210> 7
 <211> 168
 <212> DNA
 <213> Globodera rostochiensis

<400> 7
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 <211> 136
 <212> DNA
 <213> Globodera rostochiensis

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 tacgtcgacg acgaggctaa gcttacgctt cagggtctcc aacaatacta cgtagactg 120
 aaggaaaatg agaaga 136

<210> 10
 <211> 141
 <212> DNA
 <213> Globodera rostochiensis

<400> 10
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 tcaatagctc gctcgggtacc t 141

<210> 11
 <211> 141
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AKK110P1

<213> Globodera rostochiensis

<400> 11

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 aagtagccgt atttgcgaaa t 141

<210> 12

<211> 37

<212> DNA

<213> Globodera rostochiensis

<400> 12

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<210> 13

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<212> DNA

<213> Globodera rostochiensis

<400> 13

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 ccacagcgcc aacccacac caaatgcgaa atttatcgaa a 161

<210> 14

<211> 306

<212> DNA

<213> Globodera rostochiensis

<400> 14

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 gacgaatctg agatacgcac tttgtgcatc aaaacacgtg aaattttgct gtcgcagcca 180
 atcttgttgg agctcgaggc accttataaa atttgtggtg acattcacgg acaatataat 240
 gatcttctga gattgttcga atatggtggg tttccaccgg aagcgaacta tctatttctt 300
 ggggac 306

<210> 15

<211> 261

<212> DNA

<213> Globodera rostochiensis

<400> 15

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 tgaatgcaaa cggagggttc tcaatcaagt tgtggaagac ctctactgac tgcttcaact 180
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<210> 16

<211> 151

<212> DNA

<213> Globodera rostochiensis

<400> 16

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 tggcgttttt gcgccacgtc cattgtgcgg a 151

<210> 17

<211> 306

AKK110P1

<212> DNA

<213> Globodera rostochiensis

<400> 17

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ttgagaagac aaacgaaacg tticgtctgg tgtacgatgt gaaggccgt ttgtcatcc 180
atcgaattca aaagctggag ggccagtaca agctgtgcaa agtgaagaag caggccgtcg 240
gggacaagca ggtcccctac attgtcacac atgacgcgcg caccattcgc taccggaccg 300
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<210> 18

<211> 528

<212> DNA

<213> Globodera rostochiensis

<400> 18

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gttcctaccg tatacaaacg ctgtaataaa tgaaacaatt cgattagtca atttgatccc 180
gttcaatctt agccatttgg cgcttgaaga tatgcaaatt ggcaatttta ttgtgaagcg 240
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gcccgatcgg ttttgcggc aacgctttct ggacgatgag ggccgtttga agaaaagcga 360
cgaacttatt gcatttgggg ttgggaaaag gcaatgtgcc ggcgaagctt tggcccgaat 420
gacacttttt ctgtttgccg ctaatttctt tctcgcctac aaagtctctc cgtccgatcc 480
actgaatcct ccaagcctga aaaagttggc ggattatctg tttacaca 528

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<210> 19

<211> 335

<212> DNA

<213> Globodera rostochiensis

<400> 19

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ggcgccgatg ttccccgact cccagttcat cgatttgatt tcgcgcgaca tcgaatcctt 180
ctccggccca ttgggcggtt gccataaatt tatgagcggc ggtgcccgtg agggcggtcca 240
acagctaggc cccgaggggc cctttgagca gcggcaacag gtgaagagtg acaatgttct 300
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<210> 20

<211> 52

<212> DNA

<213> Globodera rostochiensis

<400> 20

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<210> 21

<211> 190

<212> DNA

<213> Globodera rostochiensis

<400> 21

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aattcatctt cagcgggcg gagggagccgc gccgtcgaaa acgctcttgt cgcccggctt 180
cggccaaccg                                     190

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<210> 22

<211> 52

<212> DNA

<213> Globodera rostochiensis

AKK110P1

<400> 22
ccgctacaac ccctacctgg agggcgcccc gctgaagtca gtggccaaaa ag 52

<210> 23
<211> 54
<212> DNA
<213> Globodera rostochiensis

<400> 23
gaattccgac tctcaaggtg gaccacgccc caaccaacag caattgtcag ctgc 54

<210> 24
<211> 77
<212> DNA
<213> Globodera rostochiensis

<400> 24
ccgcacatgt cgaggcctcc atcttttggc actggtcatc accttccgcc tactgctaac 60
aacagaccgg aacagca 77

<210> 25
<211> 439
<212> DNA
<213> Globodera rostochiensis

<400> 25
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tccattccgt ctcttctaca tcagcaacac aatcacattc cacgcccagt tttatgacac 120
acaacgtgca gcagcaacat gttgttggtc aacaacagca gcaacaacag aatttccaac 180
aaccgccgcc cctatcgtag actcacagcc accaacaaca aaaacaacca ccacaagcgt 240
cacagtcgat gttgtcaatg aaaagtggca atgttgctgt tgttggtccg caacaatcgc 300
agcagcacca ctaccaacag cggacactga cgccactgaa gcacacatcc gcatcctcca 360
cgtccgatcg cttcgtcatc accaaaacca acagggtgct tccactcccg tcgcagcaag 420
gcgccacggc cactgatga 439

<210> 26
<211> 539
<212> DNA
<213> Globodera rostochiensis

<400> 26
gaattcgttt gagacacatc caattaatta atagttattg ttggcaatgg gacgagttcg 60
aacgaaaact gtgaagaagg cgtcgcgcgt cattattgag aagtattaca ccaaattggg 120
cctcgacttt cacaccaaca agcgcatctt cgaggagggt gccattatcc caagcaaacg 180
gatgcggaac cgaattgcgg gatttatcac acatctgatg aagcgcatg agctgggccc 240
tgtccgtggc atttccatca aattgcagga ggaggagcgc gagcgtcgcg acaattacat 300
gcccgaatc tcttacctgg atgcgcagaa tcaccagatg atcagcaccg accaagagac 360
gaaggatatg gcggaatttc tggggctagg cctcaacttg gaagtgaag ggcctttgac 420
gagtggcggc gctggcgcag gacgtcgttg agtcaggaca attggcatta ttgttgaaaa 480
atcatcgatg ttttgttcgc atttggatga taatgcgctg ataaattttt gttagatttt 539

<210> 27
<211> 179
<212> DNA
<213> Globodera rostochiensis

<400> 27
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cggccgaaaa gcgtgcggca gaaaagatta atgatgcccg gaagcgaaaa gcacagcgac 120
ttaagcaggc caaacaagaa gccaggcgag agatcgagca gtatcgnag gagagggag 179

AKK110P1

<210> 28
 <211> 133
 <212> DNA
 <213> Globodera rostochiensis

<400> 28
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 gtcgctggag gcaatgaatc gcaatgtcgc ggccaacaaa cagcaggtca ttgtacgtct 120
 gctgcagttg gtg 133

<210> 29
 <211> 482
 <212> DNA
 <213> Globodera rostochiensis

<400> 29
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 caaaaggcga tgtgtttggc aaagatcagc caattgttct cgttctcctc gacattccac 180
 cgatggccga agtactctct ggtgtccatt ttgaattgat ggactgtgcg ttggcaaac 240
 ttgcccgtgt ggaggctgtg accacggaag agcaggcctt caaggacatt gactacgctt 300
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 atgtcaaaat tttcaagtcc caaggcgaag cattggcccg cttttccaag cccgtncgtc 420
 aaagtctctg tgggtgggcaa cccggccaac acgaacgcgt acatttgcg aaaatatgcc 480
 gg 482

<210> 30
 <211> 605
 <212> DNA
 <213> Globodera rostochiensis

<400> 30
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 ttttctgcca ccggcacacc gtcacaatgc caaagggtca acactttggg gctgttgcca 180
 cgactccgtg atgagattga cgagtacaag aagctaaact ttcatttgta tcagtgcctg 240
 tttaaagcaa tgttcaagcc ggccggattt ttttaaggga ttattttgcc tctttgcaa 300
 tctggcactt gcactctccg tgaagccatc atctttgggt ctgctctgcg aaagatttca 360
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 gccatttctt ttatcctacg tgttcttgtt gaaaaaaatt acacacttcc tttccgagca 480
 ttagacggcc tcgtttttca ttttcttggg atgcgctcac atcaggggca gctgccagtg 540
 atttggcacc agacactgtt ggcttttgtc gagcgttacg caaaagacat aagtgcagaa 600
 cagag 605

<210> 31
 <211> 112
 <212> DNA
 <213> Globodera rostochiensis

<400> 31
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 aatgaggaaa gtgaagcaaa tgtgcccgtt tatgcgcgta atgatgaaat gg 112

<210> 32
 <211> 105
 <212> DNA
 <213> Globodera rostochiensis

<400> 32
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<210> 33

AKK110P1

<211> 425

<212> DNA

<213> Globodera rostochiensis

<400> 33

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gcgaccttgc tggatgtgat ccagtcgggc gttgccaaact tggacagcgg agttgggggtg 120
tacgctcctg acgctgaggc ttacaccttg ttcaagccgt tggtcgacct gatcatcaac 180
gactaccatg gtggccttgg tccgggcagc aagcagccgg caactgacct tggtgacggc 240
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gttcgttgcg gccgtttcct ttaaggata cccggttcaa cccgtgcttg acnaaaggan 360
aactacnttt ggagatggga aacnaaggtc nagggccgtt ttctaacatt ttnaagggcn 420
atcct 425

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<210> 34

<211> 581

<212> DNA

<213> Globodera rostochiensis

<400> 34

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tttgacggtc attccaagca gccataaac caccaaaacc aaataccccc cccaatcga 180
tccccccctt ccaattcttc cgcattattc gcattatcaa ttctaatacag cacaaccact 240
gcatcattcc tttcccggacc atacgatgct aagtgaact ttgaaaattg gcttcacgg 300
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agagaatttg atggcgagtt gtccaaagac ggacgaggct ttactggagc aatgcaaaaa 420
attgggaatc ggaacgacgc acgacaacac tttggtcgcg cgagagaacg acgtcatcgt 480
attggcggtc aagccgatgc acatcagcaa agtgacgtcg gaaatcgac ccaatttccg 540
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<210> 35

<211> 102

<212> DNA

<213> Globodera rostochiensis

<400> 35

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cccatcaaag catccggaga aacattaagg aagtttattg tc 102

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<210> 36

<211> 34

<212> DNA

<213> Globodera rostochiensis

<400> 36

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<210> 37

<211> 100

<212> DNA

<213> Globodera rostochiensis

<400> 37

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aacacacgga gagatcggtt cgtgtcaaga ggttttcgag 100

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<210> 38

<211> 176

<212> DNA

<213> Globodera rostochiensis

<400> 38

AKK110P1

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 gcgagtatcg ctgatgttac cgaggccggt gccgtgaccc aatgctatcg cgacatgggc 120
 gctcgtcacc gcgctcaggc ggatcgaatt caaatcatca aagtgcaaac ctcaag 176

<210> 39
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 <212> DNA
 <213> Globodera rostochiensis

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 ttgggaagaa ggcattcaac aaggaccgtt actgg 155

<210> 40
 <211> 35
 <212> DNA
 <213> Globodera rostochiensis

<400> 40
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<210> 41
 <211> 70
 <212> DNA
 <213> Globodera rostochiensis

<400> 41
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 gcggacgatt 70

<210> 42
 <211> 85
 <212> DNA
 <213> Globodera rostochiensis

<400> 42
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 cgtgcttccg agatgtctct ctcgg 85

<210> 43
 <211> 193
 <212> DNA
 <213> Globodera rostochiensis

<400> 43
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 attctgagtc ggccaagcca accgcgaacg gtcatttgtt atgggttccta attgttgctg 120
 tttttcaatt atttgtgta aatgactgaa tttatgatca acggtatact agtattcttc 180
 tgaaaaagct cga 193

<210> 44
 <211> 219
 <212> DNA
 <213> Globodera rostochiensis

<400> 44
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 gaagacgtcc ggcgcgttgt tatcgtata ttaagaacaa gccgtatccg aagtcgcgct 120
 ttgtgcggtg tgtacccgac ccaaaaattc gcatttttga ttggggtaga aagcgcgcca 180
 ccgttgacga attcccatgc tgcgtgcata tgatatcga 219

AKK110P1

<210> 45
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 <212> DNA
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 gactcttgg 489

<210> 46
 <211> 101
 <212> DNA
 <213> Globodera rostochiensis

<400> 46
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<210> 47
 <211> 485
 <212> DNA
 <213> Globodera rostochiensis

<400> 47
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 cacaaacatt tgtacgcctc ggaagggaca cgcaaaaggca attcgatggg aaaatgcaaa 360
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 taaca 485

<210> 48
 <211> 651
 <212> DNA
 <213> Globodera rostochiensis

<400> 48
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 caacaattgg cttcaacgtg gaaaccgtcg aatacagaaa catctcgttc actgtttggg 180
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 aacaggattt gccgaatgcg atgaacgccg ccgaactgac agacagactt ggactgcaca 420
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 ctgttgact tgcccgcgga attgatgacg attgaattta tttgtgtgtt tgcgcgcgca 600
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<210> 49
 <211> 660
 <212> DNA
 <213> Globodera rostochiensis

AKK110P1

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tgcacttgca ccaaaagtgt gccacttggt attgtcgccc aaaaaaattg gtgaagacat 180
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<210> 50
<211> 625
<212> DNA
<213> Globodera rostochiensis

<400> 50
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attcgaaaga agacgaaaa agctt 625

<210> 51
<211> 402
<212> DNA
<213> Globodera rostochiensis

<400> 51
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acaaattgag ttctatcaaa aaagcacgga ccaagaaggt ggaaatcttc aaaagagccg 180
agcagtattt ggtggagtac cgtcagaagc aacgccaat gcttgcgctg aaacgtgaat 240
cgaagaaagt cgcaattat tatgtgccag aagagcccaa actcgctttt gtggtccgaa 300
tcaaaggcat caataagatt catccgcgtc ctgcgaaggt tctgcagctt ctccgcttgc 360
gtcagatcaa caacggcgtt ttcgtaaaagt tgaacaaggc ga 402

<210> 52
<211> 433
<212> DNA
<213> Globodera rostochiensis

<400> 52
ccgacccgta catcgcttgg ggttatccga gtcagaagat catccgtcag ttggtctaca 60
aacgcggtta cgccaaagag aaggacagc gcattccaat aacggataac aacattgttg 120
agcgcagttt ggcaagcat gacgtgattt gtgtggagga tatgatccat cagatttga 180
ccggtcggac cgacttcaa acaggtgacc aacttcctat ggcctttcaa gctgagcaac 240
ccggtgggag ggttcaagaa gaagtccaat cacttttgtg gagggaggcg attatggaaa 300
ccgcgaggac caaatcaaca aattattgga aagaatggtc taatggaagg gaagcggana 360
aagaaaggaa attgnggcgt ttttctgttg ttgttttgac gataaattgt taactccaaa 420
aaaaaaaaaa aaa 433

<210> 53
<211> 768
<212> DNA

AKK110P1

<213> Globodera rostochiensis

<400> 53

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gaattcgttt gaggtcaaac tttattagcg tatttaacaa tgtccgaagg aggagcgaaa 60
aagagtagca gcggtgcaa ggggggggtt gatgtcaaga aatttgcgat cgatcttgcg 120
tccggtggta ctgcggcggc tgtctccaaa actggtgttg ctccattga acgtgtcaaa 180
ctcttgttgc aggtgcaaga tgcttccgct cacatcactg ccgacaaacg ctacaaaggc 240
attattgacg tgcttgtccg tgtgccgaaa gagcagggct ttctgtcact gtggcggtgg 300
aacttgcca acgttatccg ttatttcccg actcaagcgc tgaacttcgc cttcaaagac 360
acctacaaac gcatctttac ggagggactg gacaaaaaca agcagttctg gtcgttcttc 420
gtcatgaatt tggcctctgg aggtgcggcc ggcgccacgt cgctgacctt tgtttatccg 480
ctgggacttt gcccgtagcg gtttgcccgc tcgatgtccg aaaagctggg tcccgcgagt 540
tcaacggttt ggcccactgc atcgcaaaaa tcttcaagtc ggacgggtccc atcgggtctt 600
accgcggtt cttcgtctcc gtccagggca tcatcattta ccgcgcccgc tactttggat 660
gctttgacac cgcaagatg attttcgcgc cggatggcaa gcagatgaat ttcttctca 720
catgggccat cgctcaggtc gtcaccgtgt cgtccggtgt cctctcct 768

```

<210> 54

<211> 338

<212> DNA

<213> Globodera rostochiensis

<400> 54

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gaattccagc agattaattg gaatggctga gaacatcgaa gagattcttg ccgaaatcga 60
cggctcccaa attgaggagt atcaacgctt tttcgacatg ttcgaccgcg gaaagaatgg 120
ttacattatg gccacccaaa ttggacaaat tatgaacgcg atggagcagg actttgacga 180
aaagaccctc cgaaaattga tccgcaagtt cgacgcggac ggttccggca aactggagtt 240
cgacgagttc tgcgcgttgg tgtacacggt ggccaacact gtggacaagg acactctgcg 300
aaaggagctg aaggaggcat tccgactctt tgacaagg 338

```

<210> 55

<211> 267

<212> DNA

<213> Globodera rostochiensis

<400> 55

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gaaattcgcg ccgatctcag cgacaaggat ttggaggcgg cggtcgacga aattgacgag 60
gacggcagcg ggaagatcga attcgaggag ttctgggagt tgatggcggg cgaaaccgac 120
tgagaaaaga gcaaatcgat ccaaatccaa acggaccggt cccatttcac ctccatccgt 180
ccgtcgtatt attatatatt ccagtggaat tttccatta aaattcgggt aaagtaaaat 240
aatttgacga aaaaaaaaaa aaaaaaa 267

```

<210> 56

<211> 597

<212> DNA

<213> Globodera rostochiensis

<400> 56

```

gaattcgctg gacacttcgc atccggagta cagccacgag cagagcatcg accagaccag 60
catcccctac cagatgggtt cgaacaagta cgcctcgag aagggcagta ccggctttgg 120
acagcccgtg tgggaggtgc ttgaccgctc catctcgtag cagaaccgca agtcgcaagg 180
aatggttcgt ctacagtcgg gtaccaaccg gttcgctcc caggcgggca tgaccggctt 240
cggcacaccc aggaacacca cctatgaggc ggaggcaggc gagctgccct acgaggacat 300
gaagaagtcg gaggcgatca tcccgtccca ggccggttgg aacaagggcy actcgagaa 360
gttgatgacc aacttcggca cgccccgtaa caccaccacc aagggtcaaag tggagaattt 420
ggcggaaatt ccggaggaca ttttgctgaa aggacacggc gaggtgcgcc tgcagtccgg 480
taccaaccgg ttcgcgtccc agaagggcct cgtcgcgttc ggtaccggac gtgacgtgtg 540
ccgtgagggg gtgaacgtga acgtgctgcc gggcgacttg gagccgcttc cggagga 597

```

<210> 57

<211> 80

<212> DNA

<213> Globodera rostochiensis

AKK110P1

<400> 57
 ggcattgtgc gtctgcaagc cggtagcaac aagttcgact cgcagaaggg catgaccctt 60
 ttcggtacgg gcccgtcgtg 80

<210> 58
 <211> 513
 <212> DNA
 <213> Globodera rostochiensis

<400> 58
 gaattcgcca caccgctcac atcgcgtgca aattcgccga acttaaagag aagggtggacc 60
 gncggtctgg caagaaagtt gaggacaacc cgaagtcgct gaagactggc gacgccggaa 120
 ttgtcgaact gattccgacc aagccgatgt gtgtggaggc attcactgac tacgcaccgc 180
 tcggccggtt tgctgttcgc gacatgaggc anactgttg cgtgggcgcg atcaaatcag 240
 tggagaagac ggaaggcggg ggcaaaagtga ccaagccagc gcagaaggtc ggcgcgactg 300
 gtggcgggaa gaagacatga ccaaggggag gggcggttcc ctaagggccca accgtcgacg 360
 aaaatgagac caacctcttg tttatcggtg tcttattcag ttccttccac ccgtctctat 420
 ccatattgtc gttgcgttgg ataattgttt atttttgtt attgtcctgg ttggaaaata 480
 aatttggtca attaaaaaaa aactcgtgcc gaa 513

<210> 59
 <211> 393
 <212> DNA
 <213> Globodera rostochiensis

<400> 59
 gaattcggtt gagcgaaaaa aacatactat acaatggcaa caactgagaa gcctcaggtg 60
 gttcaacagc ccgtgcaggt ctttggccga aagaagacag caacagccgt tgcgtttgca 120
 aaaaggggca agggcttgat caaggtcaat gggcgctcct tggactacat gcagccggag 180
 attctgcgca ttaagctcca ggagccaatt ctcatgttg ggaaggacaa atttgaggga 240
 atcgacatac gaatccgct caagggcggg ggacacattg cgcaaattta tgcaattcgc 300
 caagcactgg ccaaggcact ggtagctttc taccagaaga atgtcgacga gcagagcaaa 360
 aaggaaactga aggagcaatt tgttgcttac gac 393

<210> 60
 <211> 154
 <212> DNA
 <213> Globodera rostochiensis

<400> 60
 cacgagccaa agaaattcgg tggaccggg agctcgcgct cgctaccaga atcgtagcgt 60
 taagaaataa tttttagatg caaatgtttt gatgatgac cttgtttttg ttgttgataa 120
 aaaaaattta taaaaaaaaa ccgccgatac tgac 154

<210> 61
 <211> 666
 <212> DNA
 <213> Globodera rostochiensis

<400> 61
 gtattccaag tttgagcgat cagagttctt caatctatta tcaactgttt tccatcaacc 60
 aactgtcatc atgcaaat tctgaagac gctcaccggc aagaccatca ctctcgaggt 120
 cgaggctagc gataccatcg agaactgaa agccaagatc caggacaagg agggcattcc 180
 gcctgatcag cagcgtctga tcttcgccgg aaaacagctt gaagacggac gcaccttggc 240
 cgactacaac atccagaagg agtccactct ccatctcgtg ctgcgtctcc gtggcggaat 300
 gcaaat tttc gtaagacgc tcaccggcaa gaccatcact ttggaggctg aggccagcga 360
 caccatcgag aacgtgaagg ccaagatcca ggacaaggag ggcatccgc ctgatcagca 420
 gcgtctgac ttcgccggaa aacagctcga agacgggagc actctggccg actacaacat 480
 ccagaaggag tccactctcc atctcgtctt gcgtcttctg ggaggagaga actgaatcgc 540
 gggctgatgg aaagatgacg aatatgatgt ctattcgatg acttgtctct ttcgatataa 600
 ttgattgtgt tccatttgcg ggtcatcaaa tctttatgac cccctcattg ggcatggaac 660
 gataaa 666

AKK110P1

<210> 62
 <211> 213
 <212> DNA
 <213> Globodera rostochiensis

<400> 62
 gaattcggtt gagaaacttt ttcaaccatt cattcaaagt tctcatcaag tgacacgggc 60
 agcactcaac cacgggacgc gtgtactgag cgtgttggag aaggtcaagt tggctctgctg 120
 gtttgaggag acacattcgt tcgcgcaagt ggctcgaaga taccgggcag aatttggtat 180
 ggaaccaccg cagttggacc aagtgaagaa gtt 213

<210> 63
 <211> 488
 <212> DNA
 <213> Globodera rostochiensis

<400> 63
 agcaccggct caatcctcaa tggcacaacg acggcattct ccggcatagg agacggagtc 60
 ggtcttggag aacaacagcc aattcccgtc gtaagcgatg cgggactgga tgcggaagaa 120
 cagctgagaa tggccagaat gtgagccgga ggacctgaag atttatgaac gaaattttcc 180
 agtgaagtgg accaacgctc ttcgacttta tctgctttgt gtaaagtgtg tagaatcggc 240
 ttccaattca aaggcttttc attccccaac ttttattttt gcgcaaaaaa tttcttagga 300
 taagcgtgaa taatttatgt atttgttttt tctttctttt atctccgcct cgaagtcgca 360
 agtggtcctt ttggcccgtt cccttttggt ttgaatgtta ttccattccc atcccctcac 420
 tttctcatat ttgtgacatt cagctgcatt gttcgactcc catttaaaag ttgagtgaag 480
 tgcgattg 488

<210> 64
 <211> 249
 <212> DNA
 <213> Globodera rostochiensis

<400> 64
 wccrgakbng aacahcdkdg vhwatnvcbn gschvwagc rngtcsvddb wgnhnsswtg 60
 gkgdyrbwnt msnwrmanrg artsstsgaa ttcccaagtt tgagagtata tattatttagc 120
 taataaatggc agtcggaaaag aataagagaa tgggcaaaaaa gggagccaag aagaaggctg 180
 tcgatccgtt cacacgcaaa gaatggtacg acatcaaagc gccggcgatg ttcacacatc 240
 gaaatssts 249

<210> 65
 <211> 362
 <212> DNA
 <213> Globodera rostochiensis

<400> 65
 wbcrcrbhdyb ytsgcrsnck tbdshbcysy gcdwkmtnvk hscngdckty nyykkkvbmr 60
 ntmsnwrman rgartsstsg tcaaccgtac tcagggaacg cgcatttcga gcgactttct 120
 aaaaggccgc gtttacgaag tgtcactggg tgaccttaac agcactgacg ccgactttcg 180
 aaagttccgc ctgatctgtg aagaggtaca gggcaagatt tgcctgacca actttcacgg 240
 aatgtcgttc actcgggaca aactgtgctc tattgtcaag aagtggcaca cgctcattga 300
 ggcgaatgtg gcagtgaaga ctaccgacgg tttcatgctc cgactctttt gtatcgggtss 360
 ts 362

<210> 66
 <211> 128
 <212> DNA
 <213> Globodera rostochiensis

<400> 66
 aatcaaatta agaagacgag ctatgcaaaa gcctctcagg tgcggatgat tcgtgccaaa 60
 atggtggaga tcatgcagaa agaggtctct tccggcgatc ttgaangaaa gtagtcaaca 120
 agcctgat 128

AKK110P1

<210> 67
 <211> 502
 <212> DNA
 <213> Globodera rostochiensis

<400> 67
 gaattccatt aaaaaactaa acgaacaaat ctaaagatgg ccaccgaagt ggaggaaaat 60
 gttcctacgg ttgacccatg ggggtgctgtg gaggaagtgg gtggtgaaga gtcgatgcag 120
 ttggtcagcc ttgacgttac cgaggtcaaa ctgttcggaa aatgggccct taacgatgtg 180
 gaagtgtccg acatttcgct tgtggattat attgcggtga aggaaaaggc ggccaaatat 240
 ctgccgcaca gcgccggccg ttaccaacag aagcgcttcc gcaaggccac ctgtccggtg 300
 gtggaacggt tgtctttgtc aatgatgatg cacgggcgga acaacggaaa gaaactaatg 360
 gcggtgcgca ttgtgaaaca ccccttcgag atcatcacct gctaccggag agaaccagat 420
 ccaagtgttg gtcaatgctg tgataaacag tgggcccnc gaagatttca cacgtatcgg 480
 acgtgcgggc actgttcgtc ga 502

<210> 68
 <211> 519
 <212> DNA
 <213> Meloidogyne incognita

<400> 68
 gcaaacTTTT atcaaataaa aaatttatat ttgccaaaca aatttatgaa taaaaattca 60
 ttaatcatta aaactacatt taaaatatac tttttagaga atgtcgtcta aaatattctt 120
 ttctcccctt tatgcatcta tctaaccaga cttggaagca atatggctaa tcaagtcaac 180
 aatacggcag gaatacccaa actcgttatc ataccagcta accaatttaa caaaatgcgg 240
 gttgagaacc ataagagcct cggcgctcgaa aatagacgaa tgagtgtcgc caagaaagtc 300
 ggtagaaca acctggctct cagtatatcc aagaatccct ttaagctttc cttccgaagc 360
 agtcttaatt gcattcttaa tagcctcctt cgttgctggc ttctccaaac gagcagtcac 420
 atcaacaacg aaaacgtttg ggcgtcggca cacgaaaagc catttccggt aagcttccca 480
 tccaattcat ggattgacct ttccaacagc ctttgcagc 519

<210> 69
 <211> 218
 <212> DNA
 <213> Meloidogyne incognita

<400> 69
 ttgattcttt attagtggac aatgacggaa gaccagaaga agttgccgat ggtgcctgag 60
 actgttttga agcgaaggaa agttagggct gctcagcgtg cttctctact caagaataaa 120
 ttggagaata ttaagaaggc taaggttaaa acgcaagtta tctttaaacg tgctgagcaa 180
 tacttgattg catatcgacg taagcaaaag caagagtt 218

<210> 70
 <211> 293
 <212> DNA
 <213> Meloidogyne incognita

<400> 70
 taagaaagca ggggaatttt atgtcccaga tgaacctaaa cttgcttttg ttgtgcgtat 60
 taaggggaatc aacaaggtta atttaaattt gctataaagt ttaggatggg tttagacaat 120
 tcttctcttt taatgctttc taactttttc aaaaaagtta tgattttatc acccattaat 180
 ctacaaattc tttaatttat cagatccatc ctcgtcctcg aaaagtctt caacttttcc 240
 gcttgctgca aatcaacaat ggagttttca ttaattgaa taaagctaca atc 293

<210> 71
 <211> 422
 <212> DNA
 <213> Meloidogyne incognita

<400> 71
 aatgcaatta agactgcttc ggaaggaaag cttaaaggga ttcttgata tactgaggac 60
 cagggtgttt ctaccgactt tcttggcgac actcattcgt ctattttcga cgccgaggcg 120
 taagtgttga ttttctaaga ttatatataa ctttttaaat ttttcagtct tatgggtctc 180

AKK110P1

```

aaccgcgatt ttgttaaatt ggtagctgg tatgataacg agtttgggta ttcctgccgt 240
attgttgact tgattagcca tattgcttcc aagtctgggt agatagatgc ataaagggga 300
gaaaagaata ttttagacga cattctctaa aaagtatatt ttaaattgat ttttaattgat 360
taatgaattt ttattcataa atttgtttgg caaatataaa ttttttattt gataaaaagt 420
tg                                         422

```

<210> 72
 <211> 374
 <212> DNA
 <213> *Meloidogyne incognita*

```

<400> 72
atctgagcat aaggaaactt ggcctcaagc tatagagcag accgattatg tggcaccgac 60
tgagccagtt aaactggact tcaacgttcc gcttattagt gattgggctg ctgcttctga 120
gtggcctcaa gaagaggaag ctcagggttc acctactgca ccaattgggtc agccacagcc 180
tcaacagcag caaactcaac aaggagggtga ttggaactct ggtactagtg gatggtgaag 240
ggcaggaaaa ttgatagaaa gagaaattat tatggaataa atgtaatcaa tgttgtgtgc 300
tgatttattt gttacatata caacaagttt tatittgttg tttatttaat aaaagttgtt 360
aattaaaaaa aaaa                                         374

```

<210> 73
 <211> 120
 <212> DNA
 <213> *Meloidogyne incognita*

```

<400> 73
tttttttttt tttttcttca tcaatatttt gaagtgaaga accagaagta gttgcattcg 60
agctttcaaa ttttgttttt tgattactct ttaaacaaga ttcaactgat ggtcttactg 120

```

<210> 74
 <211> 369
 <212> DNA
 <213> *Meloidogyne incognita*

```

<400> 74
gtctaaccac tctagagcta ttcggttcgt ctgtctgttg attattagat gttgattgaa 60
cagcactagt ctctgatgta gttttcttca atctcatttt taagtgatgt agaggaagtt 120
tagaattctg attgctatcg tcttctttct cttcttttaa tggctttttc aatttatctt 180
cttccttttc ttgtccattc ttttcttcat tcttttcaaa aggctcagga aattttaatt 240
cagaccgct ccttttaact gctgtatcta aagaaaaccc tctaggcaac gtcccagttc 300
cactcaaatt caattttgtt aaatttttgc cagatctaag tccttcttcc ttttgaacga 360
attgaactg                                         369

```

<210> 75
 <211> 529
 <212> DNA
 <213> *Meloidogyne incognita*

```

<400> 75
ttttgttttt tttttttttt ttatcagaaa aaagttttaat cagaaaaaaa aattaaaaca 60
aatctaaata aggtctctatt ctaagtttat atttttcttt tacataaacc gtcaaccctc 120
caagtttttc aatgcttggg ggttttaatg gatcctctgg taataatttg taggctagaa 180
aaaagtttgc agcaaaaagg aaaagcatca ttcttgctaa ggcttctcca gcacattgcc 240
ttttcccccac accaaaagct attagctcgt cagctttttt taatttcctt tcattgtcta 300
tataacgttc agggtcacaaa ttttggggat ttgggtatat ctttggatca aaaagaacat 360
ccgatacttg gggatcataa aatgtacctt taggcaacac aaactttcca acattcaaat 420
cttccaaggc taaatgcccc aaattgaaag ggactaaatt aacgagtcct aatgtttcat 480
taacaacagc atttgtataa attaatatag gtctgtgttc caaactaat                                         529

```

<210> 76
 <211> 449
 <212> DNA
 <213> *Meloidogyne incognita*

AKK110P1

<400> 76
 agtttttttt tttgaataaa agactttttt ttattaaaaat ggcttcgcaa actgcaggaa 60
 ttcaacaatt acttgcagca gaaaagcgtg ctgcagaaaa gattaatgag gcacgtaaaa 120
 gaaaggcaca acgacttaaa caagcaaaac aggaagcgca agctgaaatt gacaaaatata 180
 gagaggaacg tgaaaaacgt tttaaagagt ttgaacataa ttacctcggc gctagagatg 240
 atattgctgc acaaataaag cgtgaaactg atgagacgct taatgaaatg actcgtatg 300
 ttgctgctaa taaacagcag gtaattgttc gtctacttca acttgtctgt gacattcgtc 360
 cagaactgca tcacaattta caacttcaac ttaagcttaa tgaaaagcct gcctaatttg 420
 tagttgattg attataaaaa tgaaattga 449

<210> 77
 <211> 643
 <212> DNA
 <213> Meloidogyne incognita

<400> 77
 atttatattt gaacaaataa ttttaacaaaa aagtatggct cgaggaccaa agaagcattt 60
 gaagcgtttg gccgctccaa agaattggat gttggacaaa ttgggtggag tttttgcccc 120
 acgtcccatg tgcgggcctc acaagcttcg tgaatcgctt cctcttattt tgtttcttcg 180
 taatcgtcta aaatatgcac aatcttataa tgaagctagg atgatttgca aacaacgtct 240
 cattaagatt gatggcaagg tgcgtacaga aatgcgcttt ccagctggat ttatggatgt 300
 ggtttccatt gagaaaactg gcgaagtctt tcgtcttctc tatgatgtca aaggacgttt 360
 cattactcat cgcatcaaaa aggaagaagg tcagcttaaa ttgtgcaagg tagtaaaagca 420
 agcgattggg ccaaaaacaag ttccttatat tgttactcat gatgccgta ctattcgcta 480
 tccggatcca cacatcaagg ttgacgacac tgttgctgtt gatataaaca ctggaaagg 540
 tacagatcac attagatttg attctggtaa tgtttgatg attactggtg gtcacaacat 600
 gggacgtgtt ggtattggtt gacatcgtga acgccaccct ggt 643

<210> 78
 <211> 584
 <212> DNA
 <213> Meloidogyne incognita

<400> 78
 atttcctcta aaaatgaatt taaaagaaca acaaatatat ttaaatattc aattattatt 60
 ttttattttg gctgtcagta gttttttgac aactaaggga agtgaagtaa aacaacgaga 120
 aaataataaa ttggaatata ataaaaatga aattgagagg caaaaagagc aattaattcg 180
 agatttgatt gcctccttaa cacgtgaaag gcaatattca cgagattggc aacaatcaca 240
 acagcaacaa aatttcatta acagtttttg cccttcccca catttattcc cctcttcagg 300
 cattgaatgg ccccaacaac aacaaaaaat atttttggaa gaaggggaag tagaagaacc 360
 ttttagaggaa aatgagaagg aaaaaagagc acaaaacttt gttcgtttcg gaaagagagc 420
 acaaacattt gttcggtttg gaaaaagggg acagactttt gttcgatttg ggagagattc 480
 aaaaacatcaa cataacttgt cagatcagaa gcagttaaaa actgacaaac aataaaaatg 540
 atgaattatt taaaaatttt tttaatgatc ttttaattaa aatt 584

<210> 79
 <211> 556
 <212> DNA
 <213> Meloidogyne incognita

<400> 79
 atcaagcatt aaatatgcag atttttgtaa agactctcac cgaaaaaact attactctcg 60
 aggttgaggc ttctgatacc attgagaatg ttaaggcaaa aattcaagat aaagagggta 120
 tccgcctga tcaacagcgt ttgatctttg ctggtaaagca acttgaagat ggacgaacct 180
 tggctgatta taacatccaa aaggagtcta cacttcactt agttttacgt ctctgtgg 240
 gaaaggttca cggttcattg gctcgtgctg gaaagggctg tgctcaaact cctaaggctc 300
 aaaagcagga acataagaaa aagaagcgcg gccgtgcttt ccgtcgcatt caatataacc 360
 gtcgcttcac caatgttgct acttctgggg cgggacgccg tcgtggccct aactccaacg 420
 ctgcataaga gaatggctgt atcttgatga atgtatggg atataatcaa ttttaatacat 480
 tcgactntat gaagttttct gttattcaag ataaatcttt ttgttgaaaa aaaaaccaag 540
 tttagatga gttact 556

<210> 80

AKK110P1

<211> 424
 <212> DNA
 <213> Meloidogyne incognita

<400> 80
 aacattgttt taattaaaat ttacccctcc tgtagcaatg acatcagaca gacttggccc 60
 agtagttcca gatttgacag cccaagagac caacagactt gaacgaacta gttctttggt 120
 cgatttgga attcgggatg gagttccata tccacctagg cctgcaatta ataattgttc 180
 tccatacctg aatatgttga ctggaacgtt ttctgtacca aatgtaaaac agtacacggg 240
 tgcaataggt ctttatcgac cagcaaatcc tgtttatact tattatagct ataaatgcta 300
 ttttcgctat agaaattatc gaggctacac actgacggat gcttactggt acgaccgtta 360
 ttattatatt tcgccaatat acaaacggtc aatgttccca attagattcc ggcattctga 420
 ctac 424

<210> 81
 <211> 89
 <212> DNA
 <213> Meloidogyne incognita

<400> 81
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 caacanatta cgcgccattc ttgaccca 89

<210> 82
 <211> 168
 <212> DNA
 <213> Meloidogyne incognita

<400> 82
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 aaagacaaca taatttccaa ctttttcaat attatccttt ttaacggttt gattttgcaa 120
 ctgcgtccaa ttcgtccttc ttcttgatag catatgaatt gctcgaac 168

<210> 83
 <211> 67
 <212> DNA
 <213> Meloidogyne incognita

<400> 83
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 ccagtac 67

<210> 84
 <211> 42
 <212> DNA
 <213> Meloidogyne incognita

<400> 84
 taacacgacg aagaggcgaa acatcaacag cctgacgacg aa 42

<210> 85
 <211> 429
 <212> DNA
 <213> Meloidogyne incognita

<400> 85
 tatacgagta gaatcctccc gtggctctcc attaataaca gcgccaacaa gtatttgaac 60
 tggattctct ccagtcaaaa tatgtataat ttcaaaagcg tgcttcacaa tccgaacagc 120
 catcaacttt ttaccattgt tacgtccatg catcatcatc gaacaaacca aacgttcaac 180
 aatcggacaa tgagcctttc gaaaacgttt gatttgatat cgaccagcac tgtgcggcaa 240
 atatttggcc gatttgcctt taacagcaat ataatccact aaagaagcat cattaacttc 300
 gatatcgctt aaagaccatt taccaaacaa ttttaattca ggaaaatcaa ttgtagtcac 360
 ttgcatatcc ccttgtccac caggaacatc agttgcgccc caattatcat cagcgggttaa 420

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accatctcc

429

<210> 86
 <211> 435
 <212> DNA
 <213> Meloidogyne incognita

<400> 86
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 aattttcttt tcatcatttt ttaatttaaa aaacatttta acaaattaca agaacaacaa 120
 acataattgt ctctttttta ttataaaatt taaagtttaa taagttttta aacattctcg 180
 actggagtac gtgtacttag tgttttagaa aaggcaaaat tagtttggtg gtttgaagag 240
 acaaattctt ttgcacaagt agcgagaaga tatcgagcag aatttggaat ggaaccccca 300
 catatggatt tagttaaaaa attacatcaa cgttttctca atactggttc tgtttctaata 360
 ggaaatactg aacattttga agttaatcca acaatggaaa catcgacatc ctcaacagag 420
 ggtgtagcag atccg 435

<210> 87
 <211> 501
 <212> DNA
 <213> Meloidogyne incognita

<400> 87
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 aaagcaattt agttttatca ataaaaattaa aaatagtcaa tgtctcgttt cactcattag 120
 atttgtggcc cttaaagagg ccgtttgggt ttggttggtg tacttcagct gccttcacc 180
 aattgttcct tagccaccaa atccgtaaag agtacgtcct tggcgtttca acgcatagac 240
 gacgtccatg gctgtgaccg tctttctctt ggcgtgtacg caataagtta ccgctcgcg 300
 gatcacattt tcaagggaaga ctttcagaac acctcgagtc tcctcgtaaa tgagcccggg 360
 aatacgtttc actccaccac gacgtgccaa tcgcccggatt gccggtttgg tgataccctg 420
 gatgatatca cgcaagactt ttcggtggcg cttagcgcct ccttttccaa gtcccttttc 480
 gccittttact cgtccggaca t 501

<210> 88
 <211> 270
 <212> DNA
 <213> Meloidogyne incognita

<400> 88
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 ttagaataat aatggaatat ataaaaattaa attggatgat ttaataaaaa aaaaaaagag 120
 agaactagtc tcgagttttt tttttttttt tttttaanaa ttaacaattt atctcathtt 180
 cctcttccat gaaaattaac aaaaagacga caacttaatc ccataattaa catcattttt 240
 aagcttcagt cggcatgctt cgaataatgt 270

<210> 89
 <211> 286
 <212> DNA
 <213> Meloidogyne incognita

<400> 89
 caagcggttc ccaactcaat gttgttgcca tgatactcgt gaacaccagt tctcgccaac 60
 atagaatagt actcaatctc actgctgcta aggccttgag tattattcga aataataaca 120
 agtttagcct ttccagaacg aagagctctc aacgtctgct ttagagccaa acaatacttg 180
 cccgatttgg taaccatggc gagacgagca ttgatatttt ctgtggactt tttctgtttt 240
 ccaacaacca ttgtaacgca aaattaaaat ctctttttta acaaat 286

<210> 90
 <211> 391
 <212> DNA
 <213> Meloidogyne incognita

<400> 90

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agatatgaca tcagacagac ttggcccagt agttccagat ttgaccagcc aagagaccaa 60
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tcctaggcct gcaattaaca atgttcctcc atacctgaat atgttgactc gaacattttc 180
tgtaccaaat gtaaatacagt acacgggtgc aataggctct tatcgaccag taaatcctgt 240
ctatacttat tatagctata aatgctattt tccgtataga aactatcgag gctacacatt 300
gacggatgct tattggtacg accgttatta ttatttttcg cctatatata aacggccaat 360
gtttccaatt agattccggc actctgacta c 391

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<210> 91

<211> 131

<212> DNA

<213> Meloidogyne incognita

<400> 91

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attatccaca cacctattgg agctaccctt accaaggaaa atggtatgac tatgataatc 60
caacaaatta ccgcccgttc ttcgaccac gcatcagcgc atcattttca agaccttatg 120
attacacatc a 131

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<210> 92

<211> 571

<212> DNA

<213> Meloidogyne incognita

<400> 92

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ttggtgagac aacaaaaaaa ttttatttat tttttaacaa cagaaaaata tactttttaa 60
ttttaaatat ttttccatga ttcaacagcc atactttcct cattttaata cttcttaaac 120
cctcaaaaaa ttcattttatt gacgaccagc agcagggtgt tgctgctggt gttgaccacc 180
acccccttgc gcttgacctt gctgttgctg tcccttcacg tcaacaggca aattgagttg 240
caaataatca accatctcct tagtctcttg atcaacacta atagttggat gttgagaagc 300
atcaagatag gaaacttctg gaacccaatt atcagcagc tcacgctctt cttcttgcaa 360
tttaatatag attccacgaa caggtccttt ttcgatacgc ttcatcaaat gggtaataaa 420
accagcaatt tgattacgca tccgtttgct aggaataaca gcaatttcct cacaaattcg 480
tttgttcaca tgaaaatcat aagtcaagcg tgtataatat ttgtcaataa taacacgaga 540
tgctttcttg acagttttga gagaaccgat t 571

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<210> 93

<211> 671

<212> DNA

<213> Meloidogyne incognita

<400> 93

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tttgagaatt taacttttct aacaaaaact tttatttttg tctttgatgt ctactcaagt 60
accaatacgc gtgctgggta ctggagcagc tggtcagatt gggtattctt tggttattca 120
aattgcaaag ggtgatgttt ttggaaagga aacgcccatt gttctggtta tggtggatat 180
tcctccaatg gccgaagtgc ttaaaggagt ggaacttgaa ctttacgatt gtgccttggc 240
gaatcttata gctgtcgagc cagtcacgac tgaagaggca gcgttcaaag acattgatta 300
tgcttttctt gttggtgcaa tgcctcgaaa ggaaggaaatg gaacgaaagg atttacttgc 360
tgctaattgtg aaaaatattta aatcgcaagg attggctcta gcaaaatatt caaagccaac 420
tgtaagggtt ctgggtgttg gaaatccagc aaatacaaat gcttttattt gtgcaaaata 480
cgcagcagat aaaattccag caaagaatgt cagcgctatg actcgtcttg accataaccg 540
tgcaattgcc caaatagctg ctcgttgtgg gggtgactgt ggatctgtga agaaagtatt 600
aatttgggga aatcattcaa gtacccaatt tcctgatgtt aaacatgcta aagtaattaa 660
aggtggcacg g 671

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<210> 94

<211> 289

<212> DNA

<213> Meloidogyne incognita

<400> 94

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ggctgtaaat gatgtgccgt ggatacagaa tgaatttatt tcgaccgtcc aaadagcgcg 60
agctgttatt atcgaaaaac gcaaaactgtc cagcgcaatg tcggcagcaa aggcggcatg 120
tgatcacatt catgatggc actttggaac aaaagatggc gattggggtt ctatggccgt 180
tccttccgat gggtcttatg gaattccgga aggtttgatc ttctcatttc caattacaat 240

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tgatgcanaa acgctgact ggaaaattgt acaaagatta gaactcgat 289

<210> 95
 <211> 262
 <212> DNA
 <213> Meloidogyne incognita

<400> 95
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 acgctgctg gttactggag cagctgggtca gattgggtat tctttgggta ttcaaattgc 120
 aaaggggat gttttcggga aagaaacgcc catcgttctg gtaatgttgg atattcctcc 180
 aatggccgaa gtgcttaaag gagtggaaact tgaactttac gattgtgcct tggcaaatct 240
 tatagctgtc gagccagtca cg 262

<210> 96
 <211> 323
 <212> DNA
 <213> Meloidogyne incognita

<400> 96
 aagacattga ctatgctttt cttgttggtg caatgcctcg aaaagaagga atggaacgaa 60
 aggatttact tgctgcta atgtaaaatat ttaaatcgca aggactggct ctacgaaat 120
 attcaagcc aactgttaag gttctgggtg ttggaatcc agcagataca aatgctttta 180
 tttgtgcaaa atatgcagca gaaaaattc cgacaaagaa tttcagcgct atgactcgtc 240
 ttgaccataa ccgtgcaatt gcccaaatag ctgctcgttg tgtgggtgac tgtgggtctg 300
 tcaagatagt tataatgtgg gga 323

<210> 97
 <211> 717
 <212> DNA
 <213> Meloidogyne incognita

<400> 97
 aatattttta acaaacgatg taacagaaaa acaaagtttt ttttaacaaat tttcttgaac 60
 cttatttttt ttcaaaacat ttttttattt aaatttaaac ctctcttcat tctctttaa 120
 cactttcttg aactggagggt tcataagcat ctggacgact ttcaataact tctccacttg 180
 ctgtagtat agcaacttgt ccaccaccac ttccagcacc ctctccatgc atatccaaaa 240
 gttttccaag ttcaaatttt ggttttttca aaatttttac ttttcgaata taaacgtctt 300
 gaagtggata gaaataagaa caagactttt caatgtcttt tccaatagaa tcaggaatta 360
 atttgctgac aacttcttta agatcgcatg aagaaacctc gcgatgaata atctcaacca 420
 tcctagcagc aatttgacgc acttgagacg atttgcata actagtcttt ttcacttggg 480
 ttggagcttt ctttgtagaag ccaatacaga acaatcgaag caaataacca tcagtgtgtt 540
 tgacagcaac atttgcttca attaaagtat gccacttttt gacaatagaa caaagcttgt 600
 ctgcagtaaa agtcattcca tggaaatttg tcaacaacaa tttgccttga acctcttcac 660
 aaataagtcg aaatttgca aagtcagctt cggtgtgttt cagatcacca agagaaa 717

<210> 98
 <211> 758
 <212> DNA
 <213> Meloidogyne incognita

<400> 98
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 taacaacaaa caaaaatggg cgagcaagac aaaaagaaag ctggcgggcg cgatgggtggc 120
 aaaaagaagg atggcttcga tgccaaaaag tttgcgattg atttggtctc tggaggaaact 180
 gccgtgcgg tttctaagac ggctgtggcg cctattgaac gtgtcaagtt gttgctacag 240
 gttcaagacg cttctcagca catcgtgcc gataaacgct ataaaggaa aattgatgtg 300
 cttgttctgt tgcccaaaga acagggagtc cttgcttttt ggcgtggtta tttggctaac 360
 gtgatccgtt actttccaac gcaagctctc aactttgcgt tcaaggacac ttacaaggag 420
 atcttcatgg aaggtgttga caagaacaaa cagtttggca aattcttttt gatgatgctg 480
 tttatgagca aaaatttcct tgggttgaat agaccttaaca gttgaagagt atcttgccct 540
 ctgtgatagc tatacaacac tctcttcaat tggagattca atgttgagtg gagatgctga 600
 tagtaatcct ctgttacaat cacttaacaa ctcaatcaat tccaatgcc ctgctcagaa 660
 ttataactcc tcaacaattg gccgaagcta aaaactacgt ttcaacatgc tacagctact 720

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tcaaaatcga aacagattgt tttaaactgt tgaaattt

758

<210> 99
 <211> 154
 <212> DNA
 <213> Meloidogyne incognita

<400> 99
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 tgcctattct cgcaggttat tggcacttca cacatttgta ccaataacaa cgttaccgtt 120
 tataatcaaa ctgttcctca aagttatgcc catt 154

<210> 100
 <211> 125
 <212> DNA
 <213> Meloidogyne incognita

<400> 100
 ttcagaatac tcaaggtctt atattcgttg ttgatagtaa cgacaaagag cgtattgttg 60
 aagctcgtga ggaattgatg cgtatgttgt ctgaagacga acttcgcgat tctgtactcc 120
 tcgta 125

<210> 101
 <211> 219
 <212> DNA
 <213> Meloidogyne incognita

<400> 101
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 aaatcgtaac tggatatatcc aggctacttg tgccacttca ggagatgggt tgtatgaagg 120
 tttggactgg ttgagtaacc aattgaagaa tcaagggttaa atgagtctaa ataaaaatgg 180
 agaggggaaa gagggagagg taatttttta aggaaaaaa 219

<210> 102
 <211> 473
 <212> DNA
 <213> Meloidogyne incognita

<400> 102
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 atgggggaaa aaataggagc aagccaaaaa gccaaaaaaa aatttttttt ttaaattgatt 120
 tttgtaaatg tgtgaaaagg tgtgtgtcaa ttgtagagtc aaatgtcgtt gccttccttc 180
 cactaaaatt tctctttcct tttctttctc ttctaaaaatt ccttcaaagt cgatccaacg 240
 aaatttcagc ctctcttgga tattccaact cccaaatagc cttcaaagt ttgcctttta 300
 cgtcacgagg agtaccaaact ccagtcatac acttttgaga gtctccctta ttccaaccgg 360
 cctgggatgg aattatcgtt tctgacttct tcatactctc atatggaagt tcgccagact 420
 ccgcctcgta tgttggtgtc cttggcggtc caaaacctgt catgcccgct tgc 473

<210> 103
 <211> 114
 <212> DNA
 <213> Meloidogyne incognita

<400> 103
 ttggaccgtt aggattgtcg ccaaagaaaa ttggagaaga cattgcaaag gcaacacaag 60
 actggaaagg cttaaagggt acttgcaaact tgactatcca aaaccgaatt gcca 114

<210> 104
 <211> 255
 <212> DNA
 <213> Meloidogyne incognita

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<400> 104
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 acgtaaaaca cagtggaaat ttgacgatcg agcaaattat caacattgca cggcaaatgc 120
 gacctcgttc aatggcgaaa aaaatttgaa gggactgtta aggaaattct tggcactgca 180
 caatctgttg ggtgtactgt tgatggacaa catccacatg atattgttga tgcaatccga 240
 agtgggaaaa ttgaa 255

<210> 105
 <211> 571
 <212> DNA
 <213> Meloidogyne incognita

<400> 105
 tttttttttt tttttttttt tgtcaacaat aaattttactc agaaaaatca ttttaacaatt 60
 taacacacat ttttaattcc ttaatactcc aaaaaacttc tcttctttat tccctcttat 120
 tctcccaatt catttaaaagt ttcagttttg tgcggcgcca atgacgacgt tttgcattat 180
 agcgtatacg actgccagtt ttcattcgaa cccattgcgg cagcggtcga ttttgtttag 240
 cagccttagc cagcttgccg ttgataataa acgtttttgtg tgcagccatt aaattgttga 300
 ctttatccaa aattgttttt ttgaaggcaa taaacaaatt taatttttct gctcaacaag 360
 tccatagcag ctcatctggt caacaatctc cctcatgcgc ctcagtctcc agcgtcttct 420
 cttatgaatg tcaaaaacag cagcaacaac ccccagcaga accttgtgga ccttctttgg 480
 aagttcatca atctggtcat tcaacaacaa ccttccatc tccatgttct ttattacccc 540
 ctccctcttc ttacatcct ataatcatc g 571

<210> 106
 <211> 235
 <212> DNA
 <213> Meloidogyne incognita

<400> 106
 tgctttatct tcaattcttc aaccaaaaaat taaatcttcc cttattttta ttacaattcc 60
 aattttagca gcattagccc caactacttt agctgctaata atgaggtatg atgaggtatg 120
 agatagtgat ggacttgata tggctaaaag ttttttaaat tgaataaagg aaaaagaagc 180
 attttaaaga aaattagatg gaaatgctga agaaagaaaa aaattattta ttttt 235

<210> 107
 <211> 702
 <212> DNA
 <213> Meloidogyne incognita

<400> 107
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 tttgaaaaaa aaaaaaaaac aaaaaaaaac tgcagaagaa atccttgccg aaattgacgg 120
 ctctcaaaat gaggagtatc aacgtttctt cgatatgttt gaccgtggaa agaattggcta 180
 tattatggct actcaaattg gggtaattat gaatgctatg gaacaagatt ttgatgaaaa 240
 aactcttcgg aaattaatcc gaaaattcga cgcagacggc agcggcaaaa tcgaattcga 300
 cgaattctgc gctttggtat acactgtggc gaataactgta gacaaggaca ctttgcggaa 360
 agaattgaga gaagcttttc gtctctttga caaagagggc aatggttaca tctctcgctc 420
 aacactcaaa ggattacttc acgaaatcgc cccagacctc agcgataaag acttggatgc 480
 cgcagttagc gagatcgacg aagacgggaag cggaaaaatt gaatttgaag aattttggga 540
 gttaatggct ggagagactg attgaaattt taattagaat gactagaaaa ttgactaaaa 600
 ttttttgcca ttaaattttg gaaagtgcga aaaattgcct ttctgagaat tttttttttt 660
 aacgtctaaa taatgaataa aatggatata aaaaaaaaaa aa 702

<210> 108
 <211> 423
 <212> DNA
 <213> Meloidogyne incognita

<400> 108
 aaaattaaaa taaaagacaa acaaataaat ataaattaaa taaataatat ttaaataaac 60
 acacaaataa actctccaaa cataattttt ttaaatttta ataacatttt gtccccattg 120
 agaaagaaaa tgccaaagga gatgaagaac ttgttgaaga aaaaagttca aaatatcaaa 180
 ctccctccatt tgtcgtcaca ttttctttca ttattccatt tgttgtaagc tcagtaactg 240

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cccccaattgt  tgtttagtc  catggagaga  aagcactttc  cccattcgaa  aatgttgaac  300
caaattgggtc  aaattgttgc  tgtttagtac  ctcgaaagttc  gttagaaaca  gaacgaaata  360
aattatgagg  ttgttgttgc  tctgacggt  tttgattgtc  tggagctggg  tgaggatcac  420
caa

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<210> 109
 <211> 994
 <212> DNA
 <213> Meloidogyne incognita

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<400> 109
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gtcaaaacta  gccaaagccga  aattcaagcc  tttaaaacgt  tcaagagaag  agcaaaaaga  180
tgaaattgaa  cttgtcgatc  catcgttaaa  gggcaaaatt  attattaaag  caaacaaaaa  240
attggaaaaa  gatgttgtgt  tcaatgagga  tggagaatct  gataattctg  aagaaaattga  300
agaagaagaa  gaagacggca  atgaaaagtt  ggatgttgat  caattagtat  caaaacattt  360
ggaagattta  gatgaactaa  aattggatga  tggcgttgaa  aatgtgcgaa  agataataac  420
gaaattcgaa  taaaaataac  aaagaaaagt  ttataataaa  agctgagttt  gccgatatcg  480
acccaaaaat  tgttgatctt  ttacagaaaa  ttgggtcaagt  tttaagaaa  tatagaagt  540
gacgtatttc  caaagctttt  aaagtatttc  caactttggt  tgattgggag  aaaattatcg  600
aattaactcg  cccagatgat  tggcggcgag  ctgcaatggt  acatgctacc  aaaatatttg  660
cttcaactgc  taccctact  caatgccaaa  ggttttataa  tttgattttg  ttgccacgta  720
ttcgagatga  tattgacgga  ttaaaaaatt  acatttccat  atgtatcaat  gcttatttaa  780
agcattgttc  aaaccagctg  catttttcaa  aggaatcctt  ttgccgcttt  gcaaatcgaa  840
caatttttct  cttcgagaag  ctgttgttct  tgcttctatg  cttcgtaaag  cctccatccc  900
tcaattacac  gcggccgcag  cattgttgag  tatttcttgt  ttagaatata  cttcttcaag  960
ggcttatatc  cttcaagcat  tgatagaaaa  gaat

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<210> 110
 <211> 476
 <212> DNA
 <213> Meloidogyne incognita

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<400> 110
tttaaacact  taaaaatacc  ttcaaattta  ttttagaacc  tttttgccat  taaaaaaaat  60
tttatttcga  aaaaatggct  gagaatatag  aagaaatcct  tgccgaaatt  gacggctctc  120
aaattgagga  gtatcaacgt  ttcttcgata  tgtttgaccg  tggaaagaat  ggctatatta  180
tggccactca  aattggggt  attatgaatg  ctatggaaca  agattttgat  gaaaaaactc  240
ttcgaaaatt  aatccgaaaa  ttcgacgcag  acggcagcgg  caaaatcgaa  ttcgacgaat  300
tctgcgcctt  ggtatacact  gtggcgaata  ctgtagataa  ggacactttg  cggaagaat  360
tgagagaagc  ttttcgtctc  ttcgacaagg  agggtaatgg  ttacatctct  cgtccaacac  420
tcaaaggatt  actccacgaa  atcgccccag  acctcagcga  taaagacttg  gatgcc  476

```

<210> 111
 <211> 189
 <212> DNA
 <213> Meloidogyne incognita

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<400> 111
cgaagacgga  agcggaaaaa  ttgaatttga  agaatttttg  gaattaatgg  ctggagagac  60
tgattgaaat  ttttaattga  gatgaataaa  aaattaacta  aaatattttg  ccataaaatt  120
ttggaaagtg  ccaaaaattg  cttttttgag  aattttttat  tttaacgtct  aaataatgaa  180
taaattggat

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<210> 112
 <211> 164
 <212> DNA
 <213> Meloidogyne incognita

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<400> 112
ttgaggaaat  ttaatttttt  aaacaaatat  aataattacc  aaacaacaaa  aaagaatccc  60
aaaaacaaca  tttttaaatc  aaatgacaga  catatatttg  caataacgat  gtgtggattt  120
tctttttttt  taaataatta  acatcttaag  cctgctattt  cttc

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<210> 113
 <211> 539
 <212> DNA
 <213> Meloidogyne incognita

<400> 113
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 taacaccaac agccacagtt tgacgcatgt cacgaacggc gaagcgtcca agaggagcgt 120
 agtcagtaaa agcctcaaca cacattggct tggttggaat taagtcgaca ataccagcat 180
 ctccagtcctt caaagccttt ggattgtcct caaccttctt tccagttcga cggtcgacct 240
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 tggctctcctt tgctgggtca ttcatagagt cagaagtgc tgaaccacgt cggatgtcct 420
 tgacagagat gttcttaacg ttaaatccaa cattgtcttc aggaacagct tcagggagag 480
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<210> 114
 <211> 314
 <212> DNA
 <213> Meloidogyne incognita

<400> 114
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 tccgtcgatt tactgagatt ggttcttcta aatttgccca tcccgctttt gttccaagcc 120
 cggagaatct tgaagagta aggaaatgct cagttttggt tggttggtgct ggtgngcttg 180
 gatgtgaaat ttgaaaaat ttggccttat caggatttca aaatattgaa gttattgata 240
 tggacacaat tgacctttca aatctcaaca gacagttttt gtttcgtgaa cacgatgttg 300
 gcttatacaa agca 314

<210> 115
 <211> 200
 <212> DNA
 <213> Meloidogyne incognita

<400> 115
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 gacttgactt ttatgggcaa ttttcaatta taatttggg actagattct attgatgctc 120
 gaagatgggt aaacgccaca gtgtgttctt tggtcgaatt tgacgaagaa aacaagccac 180
 ggccaggcac aattattcca 200

<210> 116
 <211> 471
 <212> DNA
 <213> Meloidogyne incognita

<400> 116
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 gagccattgt tgattgtagg aaaggacaaa tttgctggaa tggatattcg catccgtgtc 180
 aaaggtgggt gtcattgtgc acaaatttat gcaattcgac agtcaattgc taaagttttg 240
 gtggcctatt accagaaaaa cgtggatgag caaagcaaga aagaattgaa ggatcaactt 300
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 ggaggacctg gtgctcgtgc tcgttatcag aaatcttatc gttagaagat atgaaattat 420
 aaaattgtgt gtacgaatt aattgttatt ttgttgggat aaatntgaat a 471

<210> 117
 <211> 593
 <212> DNA
 <213> Meloidogyne incognita

<400> 117
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tccaagttgt	ggctgtcaat	gacccgttca	ttgatcttga	ctatatggtc	tatatgttta	180
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ctccatctgc	tgatgctcca	atgtttgtgg	ttggtgttaa	tgaggacaaa	tatgatcctt	480
ccaagcatca	tatcattagt	aatgtctcct	gcaactactaa	ttgtcttgct	cctcttgcca	540
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<210> 118

<211> 576

<212> DNA

<213> Meloidogyne incognita

<400> 118

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tgagggggaa	gtaaaatgaa	agaagggaga	gagatatgaa	ttggagggtt	ttttgttaaa	180
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ttcgtttgtg	gaaatactaa	actttacaat	ttggttaggt	tctattttgtg	aaacataaat	300
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agcccttcc	gtgttcatat	ccattacgaa	aacttgggat	tctaattgac	tgcccttgatc	420
ttgattgggtg	acgccgacga	ggaagtgttc	tttctctcgg	atagcaaaga	ctcgcccaat	480
attttcagcc	tttgtgaaga	aagtgcctgt	ggggacgtaa	gcacgtctat	gttggtgttg	540
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<210> 119

<211> 559

<212> DNA

<213> Meloidogyne incognita

<400> 119

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tcaaaacttca	ttattcggct	attacagtaa	ccatctgcca	cgaaaaactc	tctgtactg	180
gcaatagcaa	cgtctgtagg	tttgcaaaaa	tgtttgcac	ctgtccctgg	aacaagcttt	240
tcgcccacac	tcataattaa	tttaaaatcc	ttgtcaagtt	tgtggacttg	atgacttcca	300
acgtcagtaa	cccaactatt	gccgtgggca	tcgattgtta	gtccatgagg	catgtaaaac	360
atgctttttc	cgtattcttc	caagactgcc	cctgattccg	tgtctataac	agcaattgtt	420
gtgtttgaaa	tgatgccag	ggatctgttt	agggtgtgtg	tctcatcaaa	cgaaaattca	480
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<210> 120

<211> 366

<212> DNA

<213> Meloidogyne incognita

<400> 120

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agttgaagga	gaactccttc	ttaattggat	taagaaagtg	acaggcgaaa	atattgctat	180
aaacggaact	agggaaaatt	ttgtgaaaca	attgaaagat	ggaaactctgc	tctgcaaatt	240
tgctaaca	attgtgccaa	attcaatcac	aaaggcacag	gcaaaaccga	acagcacatt	300
ccaatatatg	agcaatttgg	agctgttctt	aacattttatt	tcaagccaag	gagtccttag	360
ggagga						366

<210> 121

<211> 661

<212> DNA

<213> Meloidogyne incognita

<400> 121

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ggtactggag accaagtgcg ccttcgtgtt taaagatggg aaattgaaag aattttgggt 180
aaacataata aaaagacatt ttatggcaat aaaaaaatgt caaaaaagct tgtcttttaa 240
atattttggc aaaacatttt actttcacaa aatttttaaaa taaatttatg aagattgttc 300
cgtcactttc atcatttccg atcgaccttt gttgttttct aagttcgttg gccaaagaaa 360
ggatatgtaa aattgaatta tgaataaaaa taaatcactc aatcagaggc attgttagtc 420
tctcacttcc tcctctttac ccattggcta accagcttta aggatttttt ccataagttc 480
aaggtgtacg taaatcgaa accgactgtg gtatcttaat ttttccatga aattctccaa 540
taaaaaaaa ttttttttat tttttttcca taatgctatc tataattttt gcttttaatc 600
ttttttggct atcaggcttt aaaatagtaa atatacttat attaataatt tatttccttt 660
a

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<210> 122

<211> 173

<212> DNA

<213> Meloidogyne incognita

<400> 122

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gggaaattgg tcagtcaatt tgggaagcct gactccagtg aaacacccaa aaatggagaa 120
ttccttgtag cacactctct aaccctcatt gaagatctca acttactttg tgt 173

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<210> 123

<211> 584

<212> DNA

<213> Meloidogyne incognita

<400> 123

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gtccccacag gcactttctt cacaaggctt gaaaatattg ggcgagtctt tgctatccga 120
gagaaagaac acttcctcgt cggcgtcacc aatcaagatc agggcagtc attagaatcc 180
caagttttcg taatggatat gaacacagga agggctaata gctttgctaa ggggtctagaa 240
aacgccccatg cccttgcaat cagcgataat ggagatattt atgtttcaca aatagaaccc 300
aaccaaattg taaaatttag tatttcgaca aacgaaaatt gagaaaaaaa aaaaaaaagc 360
tcagaaacgg gaagaatttt caagaaaaaa ttttttacc aaacaaaaaa cctccaattc 420
atatctctcc ctctttcat ttttccttcc ctttctcccc aaaaattaca aaaaatttta 480
ttgtgcacaa aaaaatgggc gggcgggcga atggctgggc aaaggatggc gataaatctt 540
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<210> 124

<211> 650

<212> DNA

<213> Meloidogyne incognita

<400> 124

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ttattcagga ttaccacaat ggatttgac ctgaccagaa gcagccgcaa actgacttgg 360
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ctgagcttgg tggcacctat tatcctttgg aggggaatgac caaagaggtt caaactcaat 600
tgatcaagga tcacttcctc ttcaaagaag gagaccgctt ttgcaagct 650

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<210> 125

<211> 1013

<212> DNA

<213> Meloidogyne incognita

<400> 125

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gttttgaatc aaataattaa attttaaatt atttaaacag ctacacgagg cctcagcctc 180
ccccgttgca ttcaaattgg tcggcacggt tggcgatgat aattttattt tttaggtaat 240
tttgggtgaga aaatattttt aaaggtaata atgtcctttt ggacaattaa aaaaaaactc 300
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aaaaaacctt caaaatgcc aaaaatgatt atgatgagga ggaggcgcca aacgccacga 420
tggaacaaaa ggtagcttca ggtggacagc caaaacgctg ttggaaaatg gacattatcc 480
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tccggtacta accgttttgc ttcgcagaag ggaattggtg gatttggtag tggacgtgac 720
ttatgcagag aaggagtgtt tgtgagtcaa gaccagccg atttatagcc cctcccagaa 780
gagataatcc gtgctagcga tggaaattgtt cgtctccaat ccggtaccaa caaattcgac 840
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accaaacatc cggaatacaa ccacgaagtt aacattgacc aaagcgaaat tcctttgcaa 960
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<210> 126
 <211> 80
 <212> DNA
 <213> Meloidogyne incognita

<400> 126
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 cttaccaaatt gggatcaaatt 80

<210> 127
 <211> 585
 <212> DNA
 <213> Meloidogyne incognita

<400> 127
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 aagcgggcat gacaggtttt ggaactccaa ggaacacaa atacgaggcg gtagctggcg 180
 aacttccata cgaagatatg aagaagtcag aaacgataat tccatcccag gccggttgg 240
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 aacatttgaa gcgtatttgg gagttggaat acccagagga ggctgaaatt tcgttggatc 360
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 cgacatttga ctctacaatt gacacacacc ttttcacaca ttacaaaat acattaaaaa 480
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 tctcatttgg atgcaaactg gaatttttaa aaaaaaaaaa aaaaaa 585

<210> 128
 <211> 287
 <212> DNA
 <213> Meloidogyne incognita

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 agccaaatcc aaaactttac aaaaatgcaa tttttgccag taatcatgtt gttgctaaat 120
 cgcgtttctg gtactttact agtatgttgc gtcgtgttaa gaagactaac ggagagattg 180
 tttcgtgtca ggagggtttt gaaaagaaga taggctctgt aaagaattat ggaatttggc 240
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<210> 129
 <211> 175
 <212> DNA
 <213> Meloidogyne incognita

<400> 129
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<212> DNA
<213> Meloidogyne incognita

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ggagcaatag aacgcttgcg tcgcccaggc tcctcagccc tagtaacgtg aaatttcttt 180
gcaatcatcg atttgtgtag tccatttttg gctaagacct gttctaagtc ttgttcatat 240
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ccttcaccgt caccctcctgt cataaattta tgtccaaacg caatggggccc ggaagcactt 540
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<210> 131
<211> 466
<212> DNA
<213> Meloidogyne incognita

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tcctgtaggg ggtaggagca ggctgctgca gccatatatc attgggatca gcattgtcag 420
gataggtgat gcccagatag ttcaagatct tctgataacg ctggggg 466

<210> 132
<211> 266
<212> DNA
<213> Meloidogyne incognita

<400> 132
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tggaattgga agcgccttg aagatttgtg gcgatattca cggtaataac aacgaccttt 120
tgcggctttt tgaatatgga ggttttccgc ctgaagcgaa ttatttattt ttgggtgatt 180
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aatcccccca aaattctttt tgctga 266

<210> 133
<211> 308
<212> DNA
<213> Meloidogyne incognita

<400> 133
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tggaataacat ttactgattg cttcaattgt ctgccaatg ctgctgtgat cgatgagaaa 120
atattttgtt gccatggagg tttgtcacca gatttgcaga atatggagca aattcgaaga 180
attatgcgac cgacggatgt gccagataca ggtcttctct gcgaccttct atggtctgat 240
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<210> 134
<211> 335
<212> DNA
<213> Meloidogyne incognita

AKK110P1

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 tttttgaggg tttaatgact ggacttataa acaatcaacc aatcgatcct attcaatttt 180
 tggagaatgc aatagctaaa cttcgaaaaa atcctgatct tccattaaag tgggatactt 240
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 atgcagtttc ttataaaca agcactccta tcgaa 335

<210> 135
 <211> 506
 <212> DNA
 <213> Meloidogyne incognita

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<210> 136
 <211> 230
 <212> DNA
 <213> Meloidogyne incognita

<400> 136
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<210> 137
 <211> 216
 <212> DNA
 <213> Meloidogyne incognita

<400> 137
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 ttattaatta ttatttctca tgattgtaaa ttgcat 216

<210> 138
 <211> 395
 <212> DNA
 <213> Meloidogyne incognita

<400> 138
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 ctctgttctc gttatgtgtc acactcgcga acttgctttt caaatttcaa aggaatatga 180
 aagatttagc aaatatatgc ccggaactaa ggtttcggtt ttctttggtg gtatgccgat 240
 caagaaggac gaggagactt tggctaagaa cactccgcac attgttgttg gcactccagg 300
 gcgtctgctg gcgttgggac gtacaggaca attgaagctg aaaaacatca aattcttcgt 360
 tttagacgaa tgtgacaaaa tgattgggga cgctg 395

<210> 139
 <211> 591

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<212> DNA

<213> Meloidogyne incognita

<400> 139

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gactggcagt	cacttactga	agtcaaggaa	atgggtctta	tgctgttgaa	ctgctcctgt	180
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aacccaaagg	gcagagaaca	cgacctttcg	gcatatgct	catgcatggg	aaaagccaac	420
gaatttggtc	gaattgcggg	aatggattat	attcctgcaa	caatttacat	gccgaatggg	480
aacaacatat	attggccatc	gacgatgac	gcgataagaa	cggcagctta	tcgggggtgtg	540
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